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PRINCIPLES AND METHODS OF
PHYSICAL ANTHROPOLOGY

Patna University Readership Lectures, 1920

PRINCIPLES AND METHODS OF PHYSICAL ANTHRO- POLOGY

BY

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PREFACE.

THE following course of lectures was intended as an introduction to the study of Anthropology which is practically a new subject of study in India. My aim in preparing these lectures was to present intending students with a broad outline of the subject and a brief summary of the main results so far attained by anthropological investigation and the methods employed in such investigation.

In the present course of six lectures, I have dealt particularly with Physical Anthropology including what might be called Pre-historic Anthropology. In my next year's course of lectures, I intend to deal with the methods and results of Cultural Anthropology in particular.

The scope and object of these lectures which are meant partially to meet the needs of beginners in the study of the science, necessarily preclude any claim to an original contribution to anthropological knowledge. The lectures are frankly based on the investigations of others. Although the plan is my own, liberal use has been made, as the footnotes and the bibliography at the end will show, of the works of European and American scholars and investigators, to all of whom my best acknowledgments are due.

As for the plan and arrangement of these lectures, a glance at the table of contents will show that I have dealt with the subject from an evolutionary stand-point.

Notwithstanding occasional authoritative notes of doubt and dissent as to the adequacy of the evolution theory to explain such difficulties regarding origins as present themselves, the evolutionist position in so far at least as Physical Anthropology is concerned appears to be fairly well established. Although our knowledge of the details of the evolutionary machine and the exact method of its working is as yet far from perfect, and future enquiries may reveal the need for a more or less thorough revision of the current account, the majority of scientific men are now agreed on the general position that heredity and environment operating through immense periods of time are the principal factors in originating and governing the differentiation of the races of man, as, indeed, they have been the main factors in the differentiation of the human family itself from a previous anthropogenic stock. If the paramount influence now claimed for the thyroid and some other 'ductless' glands in the differentiation of races is finally established beyond all question, the fundamental doctrine of the evolution of the human body from pre-existing forms will, I presume, yet remain materially unshaken. The evolutionist will probably recognize in this newly discovered mechanism of race-differentiation a new illustration of the operation of environment and heredity.

I cannot close this preface without offering a tribute of deep gratitude to His Honour Sir Edward Gait, K.C.S.I., C.I.E., I.C.S., PH.D., to whose kind words of advice and encouragement I have always looked for guidance and inspiration in my humble anthropological work. His departure from India will be mourned

by all students of Indian Ethnology and by none more than myself. To the illustrious Indian savant, Dr. Brajendra Nath Seal, M.A., PH.D., of the Calcutta University (now Vice-Chancellor of the Mysore University), my grateful thanks are due for certain valuable suggestions. Finally, I am indebted to the Hon'ble Mr. J. G. Jennings, M.A., C.I.E., Vice-Chancellor of the Patna University, for having kindly taken the trouble of seeing the proofs through the Press and suggesting a few verbal alterations.

RANCHI,

S. C. ROY.

The 1st December 1920.

INTRODUCTION.

THE present course of lectures were delivered in the Patna University in connexion with the University Readership in Anthropology. They were intended to serve as an introduction to the subject which the Patna University is the first in India to include within the curriculum of studies for degree examinations.

The lectures were delivered between January and March, 1920. His Honour Sir Edward Gait, K.C.S.I., C.I.E., I.C.S., PH.D., the Chancellor of the University, presided at the first lecture which was delivered in the Physics Laboratory of the Patna College on the 5th January, 1920. In introducing the lecturer, His Honour said :—

“ GENTLEMEN,— ‘ The proper study of mankind is man ’. The quotation is no doubt trite, but it is none the less very true and very apposite. Ethnology, or the scientific study of the human race, is necessarily a subject of the greatest interest to all educated people, and it is of special importance in our own Province, which contains such a great diversity of races, from the highly developed descendants of the Aryan tribes who were the earliest known invaders of India, to some of the most primitive Dravidian tribes which are still to be found in the remoter parts of Chōṭā Nāgpur and Orissā. It was therefore with much satisfaction that I received and confirmed the proposal of the Senate

of the Patna University to establish a Readership in Ethnology. The Readership having been established, the Senate's selection of Rai Bahadur Sarat Chandra Roy for the appointment was almost a foregone conclusion. The Rai Bahadur knows far more of the subject than any one else in the Province, and if I may say so, than any one else in India. He is not only extremely well read in the literature of the subject, which he has studied for years past, but has a very intimate personal knowledge of many Chōṭā Nāgpur tribes, and his admirable monographs on the Muṇḍās and Oraons are among the best works of the kind that I know. Those who listen to his lectures will learn a great deal, and I hope that some at least will be stimulated to follow his example and undertake research work on their own account."

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PRINCIPLES AND METHODS OF PHYSICAL ANTHROPOLOGY.

LECTURE I.

The Scope, Divisions and Methods of Anthropology, and Man's Place in Nature.

It is a most happy augury for the future of the study of Anthropological Science in this University that in the midst of His Honour the Lieutenant-Governor's multifarious and onerous duties he has found time to come and preside over this first lecture. And in my rejoicing at the happy circumstance that such a high authority on Indian Ethnology is inaugurating this first series of lectures delivered in this University, I almost forget my own inefficiency as an exponent of the science.

The subject of this evening's lecture is "The Scope, Divisions and Methods of Anthropology, and Man's Place in Nature".

The faculty of Wonder in the human mind is the mother of all sciences. It is to his sense of wonder in the presence of the mysteries in and around him and the consequent intellectual curiosity to probe the seemingly miraculous phenomena and processes of Nature, that Man owes his ever-growing advance in knowledge. Of all the apparent miracles of the universe there is none greater than Man himself. And the science which seeks to understand Man—his origin, natural history, and the goal and meaning of his life—can therefore legitimately claim to be a most important branch of human study. As nothing concerns man more than Man himself, a course of Anthropology should appropriately form an indispensable part of every system of liberal education. And to the University of Patna belongs the credit and honour of being the first Indian University to recognize the importance of this science and assign to it its proper place, if not as yet among the subjects of undergraduate study, at any rate among those of post-graduate study.

No province in India affords a better field for the study of Anthropology than Bihār and Orissā. This province, in fact, forms a veritable anthropological museum in which we may study *in situ* the various stages in the slow and laborious evolution of human culture. Here we have a wide field for the study of the growth and decay of such primitive institutions as totemism and animism, magic and exorcism, bachelors' dormitories and capture marriage,—phenomena so dear to the heart of the anthropologist. Here we meet with almost every grade and type of moral and material culture, from the heirs of historic civilization in Bihār proper down to semi-savage forest tribes in Chōṭā Nāgpur and Orissā. In the lowest rung of the ladder of civilization we find such primitive hill tribes as the semi-savage Juāṅgs of Keonjhar whose men used to go naked and whose women wore leaf-girdles as their only clothing but thirty years ago, the equally primitive Pahrās of the Dolma hills in Mānbhum some of whom have been known even quite recently to clothe themselves in times of stress, in a sort of rude bark cloth, the Hill Korwās, the Hill Khārīas and the Uṭhlu Bīrhōrs of Chōṭā Nāgpur who still lead a semi-nomadic existence living mainly by hunting wild animals and gathering jungle products, and a number of other tribes such as the Savarās of the Orissā hills and the Asurs and the Birjās of Chōṭā Nāgpur, who have hardly yet emerged from a precarious semi-nomadic existence. In the same category might perhaps be classed the short, sturdy, black Dravidian Malérs or Sauria Pāhārīas of the Rājmahal Hills, whose nasal index, according to Risley, approximates closely to that of the Negro, and whose elaborate annual sacrifice of twelve goats and twelve pigs to the Chāmdā Gosāi is probably reminiscent of an older human sacrifice such as is still secretly practised by their cousins the Orāons of Chōṭā Nāgpur; and the Dravidian Kuis or Khoṇḍs of the Khoṇḍmāls with their complicated system of exogamous septs and sub-septs—*gōchis* and *klāmbus*,—who openly practised the Meriah human sacrifice to their Earth goddess *Tari Pennu* until quite recent times, and who still retain the curious practice of the *coûvade*¹ which requires the father to be in seclusion immediately after the birth of a child.

Slightly above them rank those aboriginal tribes of Chōṭā Nāgpur and Orissā like the Muṇḍās, the Santāls, the Bhumijs, the Hōs and the Orāons who although they have settled down into regular agriculturists still retain their totemistic social organiza-

¹ Vide *Journal of the Bihar and Orissa Research Society*, Vol. I (1915) p. 275

tion, animistic religion and other primitive institutions and beliefs, customs and habits, more or less intact, including even the occasional secret indulgence in human sacrifice called *Oṭongā* by the Orāon, *Oṇḍkā* by the Muṇḍā and the Hō, and *Oṛngā* by the Santāl, the Bīrhōr and the Bhūmij.

Hardly more advanced are the large number of tribes and castes exhibiting varying degrees of mixture of races and cultures and exemplifying in their religious ideas and practices the interaction of Hinduism and, in some instances, of Christianity on primitive animism. Such, for instance, are the Sub-Himalayan tribe of the Thārus of the Champāran district reputed as great sorcerers, whose slanting eyes, high cheek bones and scanty beards and moustaches indicate a slight strain of Mongolian blood, and who, in addition to the animistic worship of spirits like *Kuā* or the village-well, Bōṭni Devi or the spirit of the Bhotan Hills, and the Chandi-spirit represented by a knob-headed post, have taken to the regular propitiation in their own rude way of the now Hindu deities of Kālīkā, Bhagabati and Śiva represented in their hut-temple called the *mōr* by an iron trident or *trisul*; and also perhaps the Pābri Bhūiyās of Bonāi and Keonjhar in Orissā whose slightly tawny colour appears to indicate a strain of non-Dravidian blood and whose religion is a curious mixture of unassimilated Hindu forms with essentially animistic ideas and rituals.

We next see, one after another, various other intermediate strata of the population, exhibiting different grades of culture from that of the Dōms and Musahārs of Bihār and the Pāns of Orissā at the bottom, up to the philosophic Aryan Hindu represented by the higher types of Maithil Brāhmans at the top.

As for our hill tribes, contact with higher civilization and, in matters of religion, Hindu influence on the one hand and Christian influence on the other, are fast transforming their primitive ideas, habits and beliefs which would supply the most valuable material for the generalizations of Anthropology.

And as for most of those mechanical and other contrivances of our primitive tribes which seem to take us back to the childhood of man,—such, for instance, as the fire drill by which several hill tribes of Chōṭā Nāgpur still produce fire by friction; the sling or *ghūr-pūni* (the proto-type of the civilized catapult) employed in their tribal fights by the Orāons, the Muṇḍās and other tribes to cast stones at their enemies; the weighing-beam still in use in parts of Chōṭā Nāgpur and Orissā; the bull-roarer used as a play-thing by Hō and Santāl children; the *dhebsā lebdā*—a sort of non-return

boomerang—still used by the Orāons in hunting; the Orāon *kārdhīni* or long coil-upon-coil of waist girdle made of creepers to which the first beginnings of clothing may perhaps be traced; the digging stick used by the Asurs and the Kōrwās of Chōtā Nāgpur; the long-barbed arrows hanging by the barbs from the matted hair of the Kōrwā and the Juāng; the leaf-hats and leaf-umbrellas extensively used by the hill tribes of Chōtā Nāgpur to shield themselves from the rain and the sun,—these and other interesting infantile crafts and industries are being fast replaced by inventions and manufactures of modern civilization.

And one can never exaggerate the force of Dr. Haddon's exhortation: "*Now* is the time to record. The most interesting materials are becoming lost to us, not only by their disappearance, but by the apathy of those who should delight in recording them before they have become lost to sight and memory".

Fortunately, such apathy cannot be laid at the door of the authorities of the Patna University. It is none too soon, however, that they have decided to include Anthropology in the curriculum of the post-graduate studies of the University. And it is only reasonable to expect that a gradually increasing number of our students will utilize the advantages of anthropological study and research afforded by the many interesting castes and tribes and the prehistoric remains of their Province, and the facilities for such study and research which, it is expected, the Patna University will before long provide for its *alumni*. Some of the puzzling problems of Indian Ethnology—the Dravidian problem, the Mon-Khmer-Khāsi-Ho-Muṇḍā problem, the problem of the Copper-Age and the Stone-Age men of India,—will probably depend for their solution in no small part on the results of anthropological study and research in the highlands of Chōtā Nāgpur and Orissā.

As an humble student of anthropological science in this Province, I welcomed with enthusiastic delight the decision of the Patna University to include Anthropology among its recognized subjects of study. And in beginning the present course of lectures, intended only as an introduction to the study of Anthropology, my first impulse is to offer a tribute of sincere thanks to the University authorities—and particularly to His Honour Sir Edward Gait, the Chancellor of the University, for what they have done and in anticipation of what more, it is expected, they will do in the near future to encourage and advance the cultivation of this science. With these prefatory remarks I proceed to the subject of my lecture.

Anthropology (Gr. *Anthropos*, man, and *logos*, (discourse)—
 or the Science of Man—aims at a systematic
Scope of study of mankind in the process of evolution.
Anthropology. In its widest aspect, Anthropology seeks to
 trace out the whole history of Man on earth, and to discover, so
 far as possible, the forces and conditions regulating the successive
 changes that have marked his gradual evolution as a man and
 as a race and the general principles or tendencies that underlie and
 govern these changes. As man has a body and a soul in intimate
 connexion each with the other, it studies man both on his physical
 and on his psychical or mental and moral (including religious) side,
 and, so far as possible, the interactions of the one upon the other.

On the physical side, Anthropology seeks to trace the genesis
 of man, to determine his place in the animal kingdom and to
 study his gradual development as distinct racial units exhibiting
 distinct physical and mental types in different geographical areas.
 On the psychical side, it attempts the no less interesting and still
 more important task of tracing the evolution of the human mind—
 of man's thoughts and aspirations, his customs and beliefs, his occupa-
 tions and institutions, arts and industries from their earliest begin-
 nings. It applies itself to trace the whole cultural history of man—
 his material, social and intellectual, including moral and spiritual,
 development through the probable successive stages of his upward
 march,—first as the plant-feeder and gatherer, then as the hunting
 and fishing savage, next as the pastoral nomad, then as the settled
 agriculturist, and, finally, as the busy manufacturer and man of
 industries. Not that every race or tribe has exhibited a regular
 succession of such sociological types and evolved regularly from
 gatherers to hunters, thence to pastoralists and next to agriculturalist
 and ultimately to industrialists. But ethnological investigation of
 the different types of culture occurring in different regions of the
 world would appear to indicate that these are the successive
 grades of culture through which mankind as a whole has evolved,
 although in different surroundings and circumstances the different
 activities may have appeared in different order and owing to
 racial contact and borrowing or transmission of cultures, some
 peoples may have passed at once from the hunting to the agricul-
 ture stage, and even the same cultural features may not always
 have developed from the same causes. Anthropology has in this
 connexion to investigate the modes of subsistence and of self-
 defence that man has devised and adopted at different stages of his
 development—his food, his tools and weapons, his clothing and
 housing, his games, sports and amusements, his social and economic
 organization, his forms of government, his language, art, literature,
 and laws, and last but not least, his morals, superstitions and religion.

As the heavy programme thus outlined covers an immeasurably vast field involving biological, anatomical, physiological, geological, geographical, archæological, technological, psychological, ethical, theological, historical, linguistic and economic investigations of great importance and complexity, Anthropology now practically restricts itself to the investigation of the earlier stages of man's evolution, relegating its later stages to such branches of study as Sociology, Archæology and History. Again, on the same principle of division of labour, the function of Anthropology is now-a-days restricted at least by continental anthropologists to what Broca calls "the Biology of the human species"—the study of man as an animal, including a comparative study of the structural differences between man and the higher apes as well as between members of the different races of mankind. English anthropologists would prefer the name Physical Anthropology or Somatology for this branch of General Anthropology, and retain the word Anthropology for the study of man in its widest aspect.

The other great division of General Anthropology is Ethnology which takes up the study of man where Physical Anthropology leaves it. While Physical Anthropology studies man as an unit in the animal kingdom, Ethnology (Gr. *ethnos*, race, and *logos*, discourse) studies mankind as so many ethnic units, and traces man's development through the family and tribal stages into racial and national life and the distribution and inter-relations of the tribes, peoples and nations thus formed. Ethnography, which is a subdivision of Ethnology, is the systematized description of a special people or group of peoples taken independently one of the other.

The term Ethnology is, however, often employed in a somewhat vague sense for any ethnological study; and each country, nation, or race is said to have its own Ethnology. It would perhaps be a less confusing and more simple classification to adhere to the division of the entire field of the science of Anthropology primarily into two branches—Physical Anthropology and Cultural Anthropology.

In such a classification the function of Physical Anthropology will be to study man on his physical side, to determine his place in the order of mammals, his origin and antiquity, primeval home and migrations—to classify mankind on the basis of their physical characteristics into races, tribes and other groups, and to study

their genetic inter-relations, and the conditions affecting their physical evolution and their distribution over the globe. Certain mental characteristics, such as temperament and intelligence in so far as they depend on the bodily organism, may legitimately come within the scope of this division of Anthropology.

The function of Cultural Anthropology, on the other hand, will be to study the evolution of mankind as a whole on their cultural and psychical side. **Cultural Anthropology.** to trace the origin and development of their material and mental culture,—their customs and institutions, laws and morals, thoughts and languages, arts and sciences, traditions and beliefs, and to discover the conditions and forces affecting such evolution, and, by an analysis and comparison of different cultures, to trace their affinities and inter-relations, and finally proceed to classify tribes, races, and other human communities according to their predominant cultural characteristics.

To that division of Anthropology which concerns itself with the classification of existing human groups by **Ethnology—** comparing and correlating their physical and **General and** cultural affinities and the formulation of general **Special.** laws governing their physical and cultural inter-relations, the term General Ethnology may be appropriately applied; whereas the term "Special Ethnology" might be advantageously given to that division of the science which restricts itself to the systematized study of the physical as well as the cultural characteristics of a particular ethnic group or groups inhabiting a particular area and the forces and influences moulding these characteristics and their inter-relations with other groups.

The term Ethnography might be restricted to a systematic description of an individual tribe or other **Ethnography.** small human group by itself. In this scheme, Ethnography and Special Ethnology are the handmaids of Anthropology, systematically collecting material upon which both the Physical Anthropologist and the Cultural Anthropologist base their respective classifications, generalizations and conclusions.

The inter-dependence of the different subdivisions of the science should, however, never be lost sight of by the student, who should study the science as a connected whole, although later on he should do well to specialize in the particular branch of the science to which he may feel specially attracted.

I have called Anthropology a Science. Before the promulgation of the doctrine of organic Evolution **Anthropology** by Darwin and Wallace and its general accep- **—a Science.** tance by scientific men in the sixties of the 19th century, the claims of Anthropology to be reckoned among

the sciences were not generally admitted; and it used to be asserted that such sciences as Biology, Anatomy, Physiology, Philology, Psychology, Ethics, Theology and Ethnology fully covered the field sought to be usurped by Anthropology. But since then and particularly when, shortly afterwards, the startling revelations of the sister sciences of Geology, Palæontology and Prehistoric Archæology fired the imagination and broadened the outlook of scientists, it came to be generally recognized that there was a wide untrodden field for research which Anthropology might legitimately take for its own.

Although the claim of Anthropology to be reckoned among the sciences appears to be generally recognized at the present day, there are some ultra-conservative votaries of the exact sciences, particularly in India, who still seem to grudge this branch of study the dignified name of a science. They would jealously restrict the name of science only to those branches of research which yield absolute laws or laws of the timeless or mathematical kind. The answer of Anthropology to these critics may be forcibly put in the words of Dr. Marett ²:— “Anthropology is Science in the sense of specialized research that aims at truth for truth’s sake. Anthropology specializes on the particular group of human beings, which itself is part of the larger particular group of living beings. Inasmuch as it takes over the evolutionary principle from the science dealing with the larger group, namely, Biology, Anthropology may be regarded as a branch of Biology. ...Biology deals with life or, if you like, with matter as living. Matter moves. Life evolves. We have entered a new dimension of existence. The laws of matter in motion are not abrogated, for the simple reason that in physics one makes an abstraction of life, leaves its peculiar effects entirely out of account...But they are transcended. They are multiplied by x , an unknown quantity. This being so from the standpoint of pure physics, Biology takes up the tale afresh, and devises means of its own for describing the particular ways in which things hang together in virtue of their being alive. And Biology finds that it cannot conveniently abstract away the reference to time. It cannot treat living things as machines. What does it do then? It takes the form of history. It states that certain things have changed in certain ways and goes on to show, so far as it can, that the changes are on the whole in a certain direction. In short, it formulates tendencies, and these are its only laws. Some tendencies appear to be more enduring than others, and thus may be thought to approximate more closely to laws of the timeless kind. But x , the unknown

² *Anthropology*, pp. 14-16

quantity, the something or other that is not physical, runs through them all, however much they may seem to endure. For science at any rate, which departmentalizes the world, and studies it bit by bit, there is no getting over the fact that living beings in general, and human beings in particular, are subject to an evolution which is simple matter of history ”.

So far as Physical Anthropology is concerned, there can be no question that the study of man as an animal is a science. As the science of human life, it is undoubtedly, as Marett says, a branch of Biology or the Science of Life in general. As Man forms the topmost branch of the higher of the two main stems of the tree of life,—Plant Life and Animal Life,—Physical Anthropology may legitimately claim to be the highest of the biological sciences.

As for Cultural Anthropology, too, if by *science* is meant the study of the phenomena of the universe as presented to the senses, with a view to interpret and explain them by reducing them to their fundamental elements and tracing their mutual relations, causal or otherwise,—the study which embraces all the phenomena of human thought and feeling as embodied in human action, whether individual or corporate, and seeks to ascertain how they happen or hang together, can certainly claim to be a most comprehensive branch of Science. The “why” or the ultimate causes of phenomena will always remain a mystery in this as in any other science; and causation, as Mill says, is nothing more than uniform antecedence. The historical form which Anthropology adopts in its descriptive parts, does not in any way detract from its scientific character. In fact, as even Karl Pearson says, “Science for the past is a description, for the future a belief”. “That a certain sequence has occurred and recurred in the past is a matter of experience to which we give expression in the concept *causation*; that it will continue to recur in the future is a matter of belief to which we give expression in the concept *probability*. Science in no case can demonstrate any inherent *necessity* in a sequence nor prove with absolute certainty that it must be repeated”.³

Now, as for the Methods of our Science: Like other sciences dealing with forms of living matter and concerned with types and classes, Anthropology, in its investigations, besides using the usual logical methods of Agreement and Difference, and their associated methods, particularly employs the methods known as the comparative and historical methods, and the biometric method based upon the statistical method.

³ *Grammar of Science*, p. 113.

Both the comparative and the historical methods are forms of what is known in Inductive Logic as the Method of Concomitant Variations, which is a peculiar application of the Method of Difference, and postulates that "whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomena, or is connected with it through some fact of causation" (Mill's fifth canon). The comparative method as applied to Anthropology consists in a systematic observation of demonstrable agreements and differences in morphological, cultural, or social phenomena in two or more human groups, with a view either to establish causal connexions between them or to determine the law according to which the phenomena vary. The historical method is the systematic observation of coherences through periods of time.⁴ The statistical method, which is the quantitative aspect of the comparative and historical methods, consists in a systematic observation of coherences among phenomena that admit of numerical statement, and expresses their relations in an exact and quantitative form. This method with its "means" and "least squares", "curves" and "probable error", formerly followed with signal success in such sciences as Physics and Chemistry, was first applied to the study of evolution by Francis Galton. This statistical study of variation and heredity to which the name Biometry (or the measurement of living things) was applied, has since been considerably developed by Karl Pearson. Physical Anthropology is now beginning to use this method by plotting out *variation curves* in order to express the *mean* anthropometrical indices for any human group and the *mode* or the class with the greatest *frequency* (or largest number of individuals) for any particular index, as well as the *average deviation* and *standard deviation* from the same, and their *probable error*, or measure of reliability, their *co-efficient of variation* or proportionate degree of scatter of the variates, and *co-efficients of correlation* or the measure of the extent to which one character varies in agreement with another. According to this method, with regard to any character, the race type is represented not by a particular measurement, but by a curve of variations derived from statistics obtained from a large number of measurements. Thus, Physical Anthropology is passing from the descriptive to the quantitative aspect. The new school of Anthropologists are no longer satisfied with the statement that a certain race is characterized

⁴ As applied to Cultural Anthropology, the historical method otherwise called the ethnological method is by some supposed to be antagonistic to the orthodox evolutionary method otherwise known as the psychological method. The application and relative merits of these methods as also of their combination the historico-comparative method in the domain of Cultural Anthropology will be dealt with in my next year's course of lectures.

by long heads and straight eyes and another by round heads and oblique eyes, but give numbers and percentages; they are not satisfied with saying that a certain character is variable in a race, but give statistics to indicate the range of the variations and the mode of their distribution. The variation curve for any particular character in a group shows that a like character fluctuates round a mean or several means. By the correlation table devised by Biometry, the anthropologist measures heredity and further finds out what parts or processes of an organism vary in unison and to what extent they so vary. The ideal mean for each race or sub-race is arrived at by combining the means of different characters and this composite mean is regarded as the 'type'. In this way the results of Physical Anthropology are being expressed in mathematical formulæ; and after this even the most conservative scientist can have no semblance of objection to admitting Anthropology to its rightful place among the sciences.

For the rest, Anthropology, like other sciences, proceeds in its investigations by the collection and tabulation of facts or phenomena with a view to detecting connexions between them and correlating, classifying and interpreting them. As in other sciences, Anthropology seeks the aid of what has been called "scientific imagination" to arrive at theories to interpret its facts. The inquirer begins with a working hypothesis suggested by one or more sets of observed facts, and proceeds to test such facts by comparison with the results of previous and subsequent investigations, and according as such a theory is found consistent or inconsistent with known facts as well as with the result of further investigation on the same or similar lines, the theory is finally accepted, modified or abandoned. Each subsequent concordance strengthens the theory, as subsequent disagreements may show the need for revision, modification or abandonment of a hitherto accepted theory. This is the recognized method of all sciences. And Anthropology forms no exception. As Sir James Frazer, one of the greatest of living Anthropologists, says, "The advance of knowledge in this, as in every other field, consists in a progressive adjustment of theory to fact, of conception to perception, of thought to experience; and as that readjustment, though more and more exact, can never be perfect the advance is infinite."⁵

So much as regards the position of Anthropology among the Sciences, its scope and divisions, and the methods it follows in its investigations. In the remaining portion of this lecture I shall try to explain how by using the comparative method,

**Scope of the
present
Lectures.**

⁵ *Lectures on the Early History of Kingship*, pp. 7, 8.

Physical Anthropology has determined the place of man among the animals. And in the lectures that follow I shall attempt to trace in outline, so far as possible, Man's gradual progress in body and in mind through untold generations reaching back to Pleistocene and even Pliocene times. I shall pass in hurried review the fascinating story, mostly conjectural, of the gradual Ascent of Man. I shall recount the probable stages by which Pre-Man—behind whom lies a long vista of animal existence—first attained, by Pliocene times through the laws of heredity, variation and natural and organic selection, to the rank of Proto-Man characterized not only by a perfectly erect attitude, bipedal locomotion and prehensile hands, and by vocal organs capable of human speech, but also by deeper convolutions of the brain and a higher cranial capacity, and by mental powers far outstripping those of all his other animal competitors in the struggle for existence. We shall next see how Proto-Man, thus equipped, set about the great task of domination over all other animals and the conquest of Nature, and how by Pleistocene and Post-Pleistocene times, he occupied the whole of the then habitable globe, and finally how these undifferentiated Pleistocene proto-human ancestral groups in their respective habitats, under the combined influence of soil, climate, food, occupation, heredity and natural and organic selection, and other causes, external and internal, working through immense periods, gradually specialized along divergent lines of evolution into the three or four primary divisions of modern Mankind—the Caucasian or the White (comprising the fair white or Xanthocroi and the dark white or Melanocroi), the Mongolian or the Yellow (including the so-called Red), and the Negroid or Black varieties of Mankind,—derived not one from the other but independently from an original common ancestral stock.

As the doctrine of evolution forms the basis of the science of Anthropology, and as it is by this doctrine alone and the laws of Heredity, Variation and Selection involved in the doctrine, that the origin of mankind and their differentiation into races and sub-races can be satisfactorily explained, I propose to devote a separate lecture to a brief account of the history and development of this fundamental principle of our science. Here, I shall only point out that it is sometimes erroneously supposed in uninformed circles that the Darwinian theory of Evolution traces the descent of man from apes. But, in fact, neither Darwin nor any of his followers nor his successors who improved upon the theory and added to it, ever suggested that Man is descended from any of the known anthropoid apes—the gorilla, the chimpanzee, the orang-outang and the gibbon. All that they mean is that Man sprang from a stock common to them and to him. The "monkey-blasphemy of Man", as Carlyle calls it, cannot be attributed with any show

of reason to Darwin and his followers and successors any more than it can be attributed to the ancient Hindu sages who postulated the gradual evolution of human personality by representing it as starting life first in the vegetable and mineral kingdoms and then gradually rising through reptilian, mammalian, and simian existence until it individualizes as Man. With reference to the misrepresentation of the evolution theory by its opponents, the words of Professor Klaatsch are well worth quoting. "Such a misconception", says he, "is best corrected by stating that apes are to be regarded as the results of unsuccessful attempts to compass the road to mankind, as degenerate branches of the pre-human stock, which in adapting themselves to special conditions of life in the struggle for existence sacrificed important parts of their anatomy, the way upward being cut off in particular by the reduction of the thumb. Whilst this was happening, a more favoured branch of the primeval stem was quietly evolving upward into mankind, retaining in the process many of the primitive characters".

Although the doctrine of Evolution may be definitely traced to ancient Hindu writings, as I shall show in another lecture, no evidence is forthcoming to show that Anthropology, or at any rate Physical Anthropology, as a distinct science, was systematically cultivated in ancient India. Vague attempts at distinguishing by colour or *varna* of the skin and the hair as well as by mental and cultural characteristics the different races or varieties of man known to them, may however be traced in the writings of the authors of the Rig Veda and some subsequent Sanskrit works. And the Indian scholar who would devote himself to sifting the vast mass of ancient Sanskrit literature and collating and classifying such anthropological and ethnological references as they may contain might render an invaluable service perhaps to Indian Ethnology and certainly to the sciences of Folklore and Cultural Anthropology. And we may reasonably expect that some students of our University may before long feel attracted to this line of enquiry. In all ethnological investigations of this kind, however, one can never be too cautious against rushing into hasty conclusions and indulging in conjectural generalizations such as emanate from a certain class of *pseudo*-ethnologists in our country. In this respect the approved methods of modern European anthropologists should form our guide. If, however, we gird up our loins to emulate patiently Western experts and pursue the necessary preliminary spade-work with the same enthusiastic devotion and perseverance, we may not unreasonably entertain the hope of founding in the fullness of time a School of Anthropology of our own. Such a school may be expected to interpret to the world the

evolution of the races and tribes of India and their mentality and culture with more intimate knowledge and better insight and, consequently, with greater scientific accuracy than European scholars, however assiduous, may hope to attain. For, most of the latter are either hard-worked administrators engaged for all too short a period as field-workers in Indian Ethnology, or arm-chair anthropologists sitting at home in Europe and drawing their conclusions and making their generalizations from unverified data which up till the present are not always accurate.

It is, however, a matter of little congratulation to us that up till the present practically the whole of the ethnological literature on India is the result of the labours of European investigators whereas we Indians have hitherto culpably neglected to take our proper share in the work. Such European scholars as felt interested in the study and investigation of Indian Ethnology did all that they could in the circumstances. But their number has been but too small and all they have been able to accomplish is only to scratch the surface of the vast field of Indian Ethnology. The wonder, however, is, not that so much has been left undone, but that hard-worked officials like James Wise, Dalton, Ibbetson, Thurston, Crooke, Risley, Russell, and last but not least His Honour Sir Edward Gait, and a temporary visitor, albeit an expert investigator, Dr. Rivers, could accomplish so much as they have done. And incalculable is the debt of gratitude which all Indian students of Ethnology owe to these distinguished pioneers in the field.

Although we must plead guilty to the charge of having neglected the science, in spite of the existence at our very doors of abundant material for its cultivation, we may take heart at the thought that much ground has not yet been lost. For, though the materials for the study of our science have been always at hand wherever man has lived, Anthropology, even in Europe, did not exist as a separate science before the publication of Darwin's *Origin of Species* in 1859; and although the first European ethnographical society was founded in Paris as early as 1800, it soon died of inanition, and it was not until long afterwards that the *Société d'Anthropologie de Paris* was founded in 1859 and *l'École d'Anthropologie* in 1876, of both of which Broca was the moving spirit. Similar societies were started in other European and American towns, such as in London as late as in 1863; in New York, St. Petersburg and Moscow in 1865; in Manchester in 1866; in Florence in 1868; in Berlin in 1869; in Vienna in 1870; and in Stockholm and Tiflis in 1874.⁶ Finally, the founder of the science of Comparative Ethnology, Edward Burnett Tylor, published his first great work, *The Early History of Mankind*, only in 1865

⁶ Topinard, *Anthropology* (1890), p. 17.

and his invaluable book on *Primitive Culture* as late as in 1871, a year after the publication of Lord Avebury's *Origin of Civilization*. It was these classical books of Tylor and Avebury that first helped to place the study of Ethnology on a scientific basis, just half a century ago.

As for Physical Anthropology as a branch of Zoology, it has been pointed out that twenty centuries in advance of his time Aristotle (384-322 B.C.) fixed the place of Man among the animals and distinguished him from the rest of the animal world by bipedal locomotion, the size of his brain, and his mental characters. And even Hippocrates (460-357 B.C.), "the Father of Physic", who lived a century earlier is now described by some writers as a pioneer in Physical Anthropology. After a long blank in the history of the science, we find in the sixteenth century Versalius (1513-1564), who was Professor of Anatomy in Padua, making certain observations on the shape of the head of various nations such as the "globular" head of the Greek and the Turks and the "flattened occiput" and "broad head" of the Germans. In the early part of the seventeenth century Spigel made the first scientific attempt at cranial measurement, and Edward Tyson, in 1699, laid the foundations of comparative morphology in his work named *Orang-outang, sive Homo Sylvestris; or the Anatomy of a Pygmie compared with that of a Monkey, an Ape, and a Man*. And the relationship of man with the monkeys was also suggested by Lord Monboddo (1714-1799) in his writings⁷ and by Sir William Lawrence (1783-1867) in his lectures in the Royal College of Surgeons between the years 1816 and 1818. It is interesting to note that these lectures were suppressed in deference to the opposition of the people as well as of the authorities.

Although Aristotle is credited with having first coined the word "Anthropologist", and the name "Anthropologium" in the sense of a treatment of man's bodily structure was first used in Magnus Hundt's *Anthropologium: de hominis dignitate*, a work which appeared in 1501, and dealt in a general way with human anatomy and physiology, the first use of the word in English is said to occur in an anonymous book published in 1655 bearing the title *Anthropologie Abstracted; or the idea of Humane nature reflected in briefe Philosophicall and Anatomical Collections*.⁸ It was only in the eighteenth century that the great German systematist Linnaeus (1707-1778), or, as he was

⁷ *Origin and Progress of Language* (1773) and *Ancient Metaphysics* (1779-1799).

⁸ Haddon's *History of Anthropology*, p. 6.

called since 1857, Karl Von Linné, who is justly said to have "found Biology a chaos and left it a cosmos," first laid the foundation of Physical Anthropology as a Biological Science by fixing in his *Systema Naturæ* (1735) man's place among the animals. He not only arranged *Homo sapiens* as a distinct species in the order of *Primates* together with the apes, the lemurs, and the bats; but went further and classified the varieties of Man by skin colour and other characters into four primary divisions—the fair-haired, blue-eyed and light-skinned European; the black, woolly-haired, snub-nosed African; the yellowish, brown-eyed, black-haired Asiatic; and the black-haired, beardless, tawny American. Although much has since been done in Europe by Dr. Beddoe and others towards comparative investigations of such features as the colour of the skin, hair and eyes, shape of the nose and the ear, and the like, the Linnæan classification of the races of man still remains substantially unaltered.

Nor has the Linnæan classification been affected by the great
Progress of Anthropological study in the West. advance in scientific classification of human races on the basis of measurements—the work of successive workers such as Blumenbach (1772-1840), the founder of craniology, who classified man by the *norma verticalis* or shape of the skull as seen from above into the square-headed Mongol, the narrow-headed Negro and the medium-headed Caucasian; Camper (1722-1789) who invented the test of the facial angle; Retzius (1796-1860), who correlated the schemes of Blumenbach and Camper, and thus invented the cephalic index; Broca (1824-1880), who added the mesocephalic head-form to Retzius' dolichocephalic and brachycephalic forms; Tiedemann who, in 1836, first determined cranial capacity by filling the skull with millet-seed and then weighing the seed,—a method which is still in use, seeds being sometimes replaced by shots (first used by Morton) or by water (first used by Volkoff),—and finally such workers as Quetelet, Galton and Karl Pearson, who have introduced mathematical methods into anthropological measurements and observations. Man's place in the animal world as determined by Linné by merely comparing the human skeleton with those of other animals has been substantially confirmed by his contemporary Cuvier (1769-1832), the founder of the science of Comparative Anatomy in Europe, who in his great work *Leçons sur l'anatomie comparée*, published in 1800, made a comprehensive survey of the whole animal organization and for the first time formulated definite laws as to the organism of man and the beasts, distinguished four distinct types of animals as the Vertebrata, Articulata, Mollusca, and Radiata, and classed man among the vertebrata. Further developments have since been added by subsequent comparative anatomists like Friedrich Mendel, Johannes

Müller, Richard Owen, Huxley and Gegenbaur. If Linnæus' genius lay in systematization and classification, his illustrious contemporary, Buffon (1707-1788) was a master in the art of description. His great work, *Histoire naturelle, générale et particulière*, which appeared in 1749, is the first attempt to present the previously disconnected facts of natural history as a connected and intelligible whole. And such authorities as Broca regard this work as having inaugurated the science of Anthropology.

In order to determine the place of Man in the zoological series, the Physical Anthropologist follows the method of Comparative Anatomy. He begins with a comparison of the bodily structure of man with that of other placental mammals and finds that they are constructed on the same general type and present the same broad anatomical features. Every bone in the human skeleton, every sense organ, muscle, nerve, and blood-vessel is found to have its counterpart in the skeleton of a monkey, a marmoset, or a bat. Even the brain, the most important of all organs, exhibits similar correspondence in man and the higher mammals. The physiological processes of the bodily functions of man and the higher mammals exhibit a general correspondence even up to the most important function of the reproduction of the species. As Darwin observes, "The whole process of that most important function, the reproduction of the species, is strikingly the same in all mammals, from the first act of courtship by the male to the birth and nurturing of the young".⁹ Even as regards minute details of bodily structure, Dr. Keith has ascertained that man has 296 characters in common with the chimpanzee, 385 with the gorilla, 272 with the orang-outang and 188 with the gibbon.

The evidence as to the close affinity of man and the anthropoid apes is thus popularly summarized by Haeckel :
Comparative Anatomy of Man and the Ape. "Comparative anatomy proves to the satisfaction of every unprejudiced and critical student the significant fact that the body of man and that of the anthropoid ape are not only peculiarly similar but that they are practically one and the same in every important respect. The same 200 bones, in the same order and structure, make up our inner skeleton ; the same 300 muscles effect our movements ; the same hair clothes our skin ; the same groups of ganglionic cells build up the marvellous structure of our brain ; the same four-chambered heart is the central pulsometer in our circulation ; the same thirty-two teeth are set in the same order in our jaws ; the same salivary, hepatic, and gastric glands

⁹ Darwin's *Descent of Man* (2nd Edition, John Murray, 1885), p. 8.

compass our digestive process ; the same reproductive organs ensure the maintenance of our race.

"It is true that we find, on close examination, certain minor differences in point of size and shape in most of the organs of man and the ape ; but we discover the same, or similar, differences between the higher and lower races of men, when we make a careful comparison—even, in fact, in a minute comparison of the various individuals of our own race. We find no two persons who have exactly the same size and form of nose, ears, eyes, and so forth. One has only to compare attentively these special features in many different persons in any large company to convince one's self of the astonishing diversity of their construction and the infinite variability of specific forms. Not infrequently even two sisters are so unlike as to make their origin from the same parents almost incredible. Yet all these individual variations do not weaken the significance of the fundamental similarity of structure ; they are traceable to certain minute differences in the growth of the individual features".¹⁰

As for the essential characters which differentiate man from the anthropoid apes, Flower and Lydekker say : "The distinction between the *Hominiidæ* and *Simiidæ* are chiefly relative, being greater size of brain and of brain-case as compared with the facial portion of the skull, smaller development of the canine teeth of the males, complete adaptation of the structure of the vertebral column to the vertical position, greater length of the lower as compared with the upper extremities, and greater length of the *hallux* or great toe, with almost complete absence of the power of bringing it in opposition to the other four toes."¹¹

A comparison of the embryonic development of man with that of other mammals, particularly the primates, reveals in clearer light the fundamental resemblances in their bodily structure. The human embryo starts from an ovule indistinguishable from that of the higher mammals, and follows precisely the same process of development. The wings of a bird, the flippers of a seal, the forelimbs of a quadruped, and the hands of man are developed from the same fundamental parts of the embryo. As Huxley says, "Without question the mode of origin, and the early stages of the development of man, are identical with those of the animals immediately below him in the scale: without a doubt in these respects, he is far nearer the apes than the apes are to the dog".¹² Again, "It is only quite in the later stages

¹⁰ *The Riddle of the Universe*, pp. 30, 31 (R.P.A. edition, Watts & Co., 1913).

¹¹ Flower and Lydekker's *Mammals Living and Extinct*, p. 740.

¹² Huxley's *Collected Essays*, Vol. VII, p. 92.

of development that the young human being presents marked differences from the young ape, while the latter departs as much from the dog in its development as the man does. Startling as the last assertion may appear to be, it is demonstrably true, and it alone appears to me sufficient to place beyond all doubt the structural unity of man with the rest of the animal world, and more particularly and closely with the apes."

This "Law of Corresponding Stages" in the development of all vertebrate embryos is so complete
Von Baer. that its discoverer, the great German embryologist Karl Ernest Von Baer (1792-1876), says of certain foetal specimens which he had preserved in spirit but omitted to label,—“I am quite unable to say to what class they belong. They may be lizards, or small birds, or very young mammalia, so complete is the similarity in the mode of the head and trunk in these animals. The extremities are all absent, but even if they had existed in the earliest stage of the development we should learn nothing, because all arise from the same fundamental form.”

If we compare the gradual development of the fertilized human germ-cell with that of the higher mammals, we find in both the same three germinal layers—the *ectoderm*, the *mesoderm*, and the *entoderm*, and find that in man as in other mammals, it is by the very same process that from the *ectoderm* arise the epidermis or the skin, the hair, various glands, the eye-lens, the entire nervous system, the nerve parts of the sense organs, the membranes of the mouth and the nose, the enamel part of the teeth and the lower part of the bowels; from the *mesoderm* arise the connective tissues of the body, the bones, the muscles, the teeth except enamel, the blood-vessels, the lymph-conducting vessels, the membranes of the heart, lungs and bowels, the kidneys and their ducts, the reproductive organs, the notochord, the fat and the marrow, and the blood itself; and finally from the *entoderm* arise the linings of the alimentary tract, of the larynx, of the trachea and lungs, the cell of the liver, the pancreas, the thyroid, and thymus.

If the "Recapitulation Theory", propounded by the German biologist Ernest Henrich Haeckel (1834-1919) as a "fundamental biogenetic law", could be sufficiently demonstrated, there would have been little need for other proofs of the theory of man's descent from earlier animal forms. Haeckel asserted that embryonic history is a shortened recapitulation of ancestral history or, to put it in zoological language, that the *ontogeny* or evolution

The Recapitulation Theory.

of the individual contains an abbreviated record of the *phylogeny* or evolution of the species. Thus, it is pointed out that the ovum or germ of the human body is a more or less irregular amœboid particle, so that man may be said to begin his existence as an amœba; after fertilization the single cell grows into a cluster and passes through a series of forms which roughly represent the long series of ancestors in past time. In the third week of its life, the embryo, less than quarter of an inch in length, has a large head and long tail with no trace of limbs except a series of five slits or folds in the throat or chest region; the rudimentary heart appears in the same position and is of the same structure as that of the fish; and its chief arteries rise in six double arches over the gill arches. This distinctively "fish" arrangement, also found in the embryos of other mammals, reptiles and birds, entirely disappears within a week or two, and is said to be a reminiscence of the Silurian fish ancestor of all the vertebrates. The nose first appears in the fourth week as a pair of simple depressions in the skin as in animals below the fish stage. The depressions then connect with the mouth by an open groove as in the shark: the grooves are closed over and form nostrils leading into the front of the mouth as in the Dipnoi. The successive development passes through the reptile and early mammal stages, the external prominence forming only about the tenth week. The development of the other parts of the embryo—the jaws, ears, heart, etc.—are equally suggestive. Before birth the whole body has a fine hairy covering like that of the ape; after birth the fingers and toes exhibit an ape-like power of grasping, and the spine remains curved until long after birth so that the baby must crawl on all fours. But the data as yet are insufficient to justify any conclusion on Haeckel's theory.

There is, however, another class of evidence which would appear to strengthen the argument regarding the community of descent of man and other mammals. This evidence is supplied by the existence of certain vestigial structures—the so-called rudimentary organs—which man possesses in common with the anthropoids. Such are the coccyx, the caecum, the appendix vermiformis,¹³ the inter-condyloid and supra-condyloid foramina of the humerus, and the fibrous traces of various muscles. While these are apparently useless in the human economy, their homologues in other animals have well-defined functions. The existence of these defunct structures is inexplicable on the Special Creation theory but are easily explained by the Evolution doctrine. As Darwin says,

¹³ The *appendix vermiformis*, though generally believed to be a vestigial structure, is by some supposed to have a function in the human economy.

"In order to understand the existence of *rudimentary organs* we have only to suppose that a former progenitor possessed the parts in question in a perfect state, and that under changed habits of life they became greatly reduced".¹⁴

Similar confirmation of the community of the descent of Man and other Mammals is afforded by what Darwin calls "reversionary structures", or structures regularly occurring in the lower members of the mammalian class and sporadically appearing in man. These structures are not found in the normal human embryo, or, if normally present, they are abnormally developed, but in a manner which is normal in the lower members of the group. Such are the enormously developed canine teeth occasionally met with in certain human individuals but normally occurring in the anthropoids, and the occasional development of certain muscles in man which are only proper to other mammals. To quote Darwin again, "these several reversionary structures, as well as the strictly rudimentary ones, reveal the descent of man from some lower form in an unmistakeable manner".¹⁵

Thus, from a study of the development of the human embryo and the later bodily structure of man, Physical Anthropology proceeds to compare the same with those of other mammals, particularly of the Primates, and, by correlating the phenomena thus observed—such as the homologies in the embryonic structure of man and of other mammals, the abnormal reversions to which man is sometimes liable, and the now useless vestigial structures—it seeks to determine man's proper place in the zoological series.

The blood-test devised by bacteriologists has been claimed to lend additional support to other evidence regarding the relationship between man and the anthropoid apes. Thus Professor Nuttall has found that when to the solution prepared for detecting human blood is added a fluid in which a stain of human blood has been dissolved, a precipitate occurs in the test-tube. Whereas the addition of a solution of the blood of any other animal will produce no result, a precipitate is obtained with the blood of an anthropoid ape, although not so plentifully as with human blood yet sufficiently to show the ape's close "blood-relationship" with man.¹⁶ A further proof of the "blood-relationship" between man and the anthropoid ape has been recently supplied by the discovery of Professor Grunbaum and

¹⁴ *Descent of Man* (2nd Edition, 1885), p. 25.

¹⁵ *Descent of Man* (2nd Edition, 1885), p. 43.

¹⁶ *Blood Immunity and Relationship* (1904).

others that the chimpanzee and orang-outang can be infected by inoculation with certain infectious diseases long supposed to be peculiar to man. Their susceptibility to be affected in this way testifies to the common constitutional nature of the anthropoid apes and man.

As the result of this line of inquiry, Man, or the family of **Man's Place** *Hominidæ*, is classed as the fifth and highest among the family of the Sub-order *Anthropoidea* of the order of *Primates* in Sub-class *Placentalia* and **Mammals.** Class *Mammalia* in the Phylum of *Vertebrata*. The family coming nearest to the *Hominidæ*, is the *Simiidæ*, or the tail-less anthropoid apes.¹⁷

This brings us to a consideration of two opposing theories of **Spiritualistic** the constitution of Man—the Spiritualistic and **and Material-** the Materialistic. The immense psychological **istic Theories.** gulf that now separates man from the anthropoid ape lends colour to the spiritualistic doctrine which, while admitting the similarity of man's physical structure with that of the lower animals, postulates the presence in him of an immaterial soul as a principle capable of conscious feeling, intellect and thought. Whereas this time-honoured spiritualistic doctrine refers the mental faculties to the operation of the soul, the materialistic theory would refer man's higher mental and psychic faculties to his larger and more highly organized brain. Both these doctrines have their advocates amongst eminent men of science.

Darwin's great contemporary and co-discoverer of the theory of Evolution, Alfred Russell Wallace, postulated the existence of a spiritual world behind **Wallace's** the natural world. Irruptions from this **Theory.** spiritual world, Wallace believed, have disturbed the natural sequence of causation,—at any rate “in the production of man's higher emotional and mental qualities, probably in the appearance of self-consciousness, and possibly in the first origin of life”. Darwin himself was merely content with remarking at the close of his *Descent of Man*, “Important as the struggle for existence has been and even still is, yet, as far as the highest part of man's nature is concerned, there are other agencies more important. For the moral qualities are advanced, either directly or

¹⁷ Systematists now divide the order of *Primates* (excluding the *Chiroptera* or Bats) into two sub-orders, the *Lemuroidea* and *Anthropoidea*. The *Anthropoidea*, again, are sub-divided into five groups or families, viz. the *Hapalidæ* (Marmosets), the *Cibidæ* (American monkeys), the *Cercopithecidæ* (monkeys of the old world excluding the apes), the *Simiidæ* (tail-less or man-like apes) and the *Hominidæ*.

indirectly, much more through the effects of habits, the reasoning powers, instruction, religion, etc., than through natural selection ; though to this latter agency may be safely attributed the social instincts, which afforded the basis for the development of the world sense ”.

An intermediate theory advocated by the distinguished English biologist Dr. St. George Mivart (1827-1900) in his books entitled *Nature and Thought* (1882), *Origin of Human Reason* (1889) and *Genesis of Species* (1871) seeks to reconcile the opposing views as to the relationship between human nature and intellect and animal nature in general. According to him, not only life but thought is a function of the animal system, the human animal excelling other animals only in height and complexity of organization, but over and above this, says Mivart, Man is endowed with an immaterial immortal spiritual principle which distinguishes him from the rest of the animal world. Thus, Dr. Mivart, while admitting evolution generally, denies its applicability to the psychical nature of man.

To carry the Evolution theory to its utmost logical conclusion it would probably be more correct and nearer the truth to say that whereas in the lower animals the spiritual principle lies dormant,—exists only in an embryonic stage, so to say—waiting for suitable conditions for its growth and unfoldment, in Man alone the spiritual essence first develops and unfolds itself. Just as the vital principle present in the tiniest atom gradually goes on developing and unfolding itself in successively higher forms, from the mould, the mite and the maggot up to the highest mammalian forms, even so does the spiritual principle possibly latent in all living organisms gradually develop and finally unfold itself in a recognizable form—as the conscious Higher Self in Man, carrying with it the promise of infinite growth from æon to æon. If the whole trend of evolution has been from lower to higher forms, it is in the logical sequence of things to expect this crowning event of the long series of growth and development which constitute cosmic evolution. This raising of the spirit from the gross clay of the animal nature looks like the fulfilment of the ultimate motive and goal of the great World-process. Ancient Hindu Philosophy from a truly evolutionist standpoint ranks the Mind with the five *Indriyas*, or organs of perception, and conceives of the spiritual principle believed to be latent in plant life and animal life, and patent in man, as controlling and guiding his physical body and the emotional nature, as well as the mind and leading him on to the ultimate goal of his existence.

LECTURE II.

The Antiquity of Man.

IN my first lecture I attempted to show how Physical Anthropology, in the truly scientific method of tabulation and correlation of facts and phenomena, proceeds in the first place to determine Man's place in the zoological series. It next proceeds to ascertain, so far as is possible, When, How, and Where the Hominidæ were evolved as a specialized zoological type.

In the present lecture I shall briefly discuss the evidence as to the When, or, in other words, as to the antiquity of man. Here, too, Physical Anthropology does not attempt to construct a history of human evolution by proceeding *a priori* from the unknown to the known, but follows the proper scientific procedure of working *a posteriori* from the known to the unknown. The anthropologist does not, like the schoolmen, soar to the skies in flights of imaginative theory-making, but delves down into the deepest strata of the earth to search patiently for any ancient skeletal and other remains that may be discovered to aid him in his enquiry. To ascertain the time when the Hominidæ diverged from the common stock of the Anthropeidæ, the anthropologist collects his evidence by the stratigraphical method employed by the geologist and the palæontologist, and tests such evidence by the comparative method of the comparative anatomist, and by the chemical methods by which the age of fossil bones may be roughly determined by the chemist.

As you know, the rocks which compose the earth's crust fall broadly into two main divisions, the older, igneous (fire-fused), or unstratified rocks, and the later, sedimentary (water-laid) or stratified rocks. The former, reaching down to an unknown depth, contain no remains of animal or plant life, but bear witness to the long series of ages during which the earth was forming its lithosphere, hydrosphere and atmosphere,—acquiring its rockcrust, its belt of seas and oceans, and its envelope of gas. The stratified rocks alone reveal the order and relation of life-forms and are thus of interest to the biologist and the anthropologist. From an examination of the fossilized skeletal remains found in

**Sequence of
Geological
strata and
their contents.**

these successive sedimentary strata of the earth, Geology has divided the fossiliferous rocks into three groups, known respectively as Palæozoic or appertaining to Ancient Life, Mesozoic or appertaining to Middle Life, and Cænozoic or appertaining to Recent Life,—while the vast sequence of earlier rocks, which owing to the absence of hard parts in the lowest forms of life present little or no fossil record, have been classed as Archæozoic or Eozoic (Dawning Life). The fossiliferous rocks again have been subdivided into smaller units called systems, which form the lowest measures of the time-scale of Geology. Thus the Palæozoic, or Primary group, has been subdivided successively from the earliest to the latest into the Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian systems; the Mesozoic, or Secondary group, into Triassic, Jurassic, and Cretaceous; and the Cænozoic, which comprises both the Tertiary and Quaternary epochs, into the Palæocene, Eocene, Oligocene, Miocene, Pliocene, Pleistocene or Glacial, and Recent systems. The systems are further subdivided into formations, but these do not concern us except that in connexion with the earliest human culture we have to refer to the successive Pleistocene or Glacial formations, known as Günz or first Glacial, Günz-Mindel or first Inter-glacial, Mindel or second Glacial, Mindel-Riss or second Inter-glacial, Riss or third Glacial, Riss-Würm or third Inter-glacial, and Würm or fourth Glacial. (*Vide* chart in Appendix I.)

The presence of fossilized skeletal remains in these successive geological strata, enables us to trace the development of the animal kingdom, not indeed from the time when the first specks of protoplasm awoke to life in the earliest Pre-Cambrian oozes and slimes, but from a much later period when, in the Cambrian age, trilobites moved in the waters that then covered the earth. In the Ordovician and Silurian systems, vertebrate life first appeared in the form of rudimentary fishes. In the next age, the Devonian, when the earth was still under water, fish life attained maturity. In the Carboniferous age, when dry land first began to appear, the first land creatures made their bow to the world. In the Permian age, the last phase of the Primary or Palæozoic epoch, reptiles made their first appearance; and in the Triassic and Jurassic ages of the Secondary or Mesozoic epoch, reptiles attained maturity and the flying dragons, precursors of true birds, and also the earliest mammals first appeared. In the Cretaceous Age, the last phase of the Secondary epoch, birds flourished; and mammals continued their development which culminated in the following Tertiary epoch. In Miocene and Pliocene ages of that epoch, such gigantic and fearful animals as the four-tusked mastodon and the sabre-toothed tiger roamed in herds in the tropical forests and swamps of the age.

But the most interesting mammals of this era, from the point of view of human evolution, were the monkeys and anthropoid apes ; and last but not least, two or three fossil remains of creatures intermediate in type between man and ape. Fossil remains of monkeys have been discovered in Eocene deposits near Paris and in other parts of continental Europe ; and remains of a sort of generalized form in monkeys are reported to occur in Eocene deposits of North as well as South America. ¹

In connexion with the antiquity of Man, it is interesting to note that the geologic deposits of each phase of the Tertiary epoch from the Oligocene onward have yielded the fossil remains of one or more varieties of the anthropoid apes such as the *Dryopithecus*, discovered many years ago in France and also in Hungary in Miocene strata, and of no fewer than four kinds of such apes which were found in the Siwalik Hills of India up to 1911 by the Indian Geological Survey. These latter are said to correspond to the four existing kinds of anthropoid apes and probably represent forms ancestral to the existing species. Besides these, Miocene deposits have yielded such intermediate simian forms as *Mesopithecus* in Greece, *Oreopithecus* in Tuscany and *Pliohyllobates* in Germany. In 1911, fossil remains of monkeys including those of an anthropoid ape of the gibbon type were discovered in the Lower Oligocene strata of the Fayum district in Egypt. This Egyptian ape, which has been named *Proptiopithecus*, has been described as standing in an ancestral relation to another form called *Pliopithecus* found in the Miocene strata of Germany (corresponding to the Mid-Siwaliks or Nagri Zone of the Punjab). It is said to have an almost human dentition, the canines being weak and the incisors and premolars being perpendicular in position. Thus the various types of anthropoid apes appear to have definitely specialized and differentiated from one another in Miocene, if not in Oligocene times. And as I have already said, such early differentiation among the anthropoid apes would seem to suggest that before Miocene times, probably by the Oligocene, if not the Eocene era, the human or rather humanoid line of evolution had diverged from the earlier common ancestral path. And the investigations of comparative anatomy into the characters of the brain of the Hominidæ and the Simiidæ would seem to confirm this inference. But a mere *inference* it is likely ever to remain, for the chances of discovering fossil remains of Pre-Man from the Miocene

¹ These latter have been named *Homunsculus Patagonicus*. This nomenclature is unfortunate as suggesting special human relations which do not really exist. On the strength of the occurrence of such Cebian fossils of the sub-order Anthropoidea in America so early as in the Eocene period, Dr. Ameghino claims the New World as the area where the Hominidæ were evolved. But there is little evidence to support this view.

and earlier strata are believed by most students of Palæontology to be very meagre. For in those ages burial was unknown and corpses exposed on the surface of the earth would either be destroyed by wild animals or disintegrate and crumble into dust; and it is sheer chance that has preserved in glacial deposits, ancient river-drifts, caves and rock shelters such osseous remains of Pleistocene man as have been hitherto discovered.

True, from the Lower Siwalik beds (Chinji Zone) of the Punjab, which correspond to the Middle Miocene of the European system, the Geological Survey of India recently unearthed certain teeth and part of a jaw which Dr. G. E. Pilgrim² of the Geological Survey regards as human in type, and the species it is supposed to represent has been christened by him as *Sivapithecus Indicus*. But authorities are not yet agreed about the human nature of these remains, which still forms the subject of controversy.³

The fossil human remains discovered by Ragazzoni in 1860 and again in 1880 at Castenedolo in North Italy and declared by Professor Sergi who examined them in 1883, to have been those of the first known Pliocene forerunners of mankind, present features so modern-looking (with small teeth and prominent chin) that they have been declared by most anthropological experts as belonging to a much later, probably post-glacial, age.

As for America, the researches of Dr. Alës Hrdlicka and his collaborators go to show that there appear to exist no reliable traces of geologically ancient man or of any precursor of the human race in that continent. The supposed skeletal remains of Tertiary man

² *Records of the Geological Survey of India*, XL (1910), p. 63; XLV (1915), p. 34.

³ The large canines and parallel rows of cheek teeth of *Sivapithecus* appear to indicate a frugivorous stage. W. K. Gregory in an interesting memoir on the "Phylogeny of Recent and Extinct Anthropoids with Special Reference to the Origin of Man" (*Bulletin of the American Museum of Natural History*, Vol. XXXV, 1916, pages 258-61), opines that the ancestral chimpanzee-gorilla-man stock is represented by the two Miocene genera, *Sivapithecus* and *Dryopithecus*, but that *Sivapithecus* is directly ancestral to the Hominidæ whereas *Dryopithecus* is more closely allied to the chimpanzee and the gorilla. Dr. Pilgrim supposes the well-known *Pithecanthropus erectus* to belong to an early offshoot from some species of *Sivapithecus*. The Indian fossil primates of Miocene and Pliocene ages so far known are :—*Dryopithecus chinjiensis* and *Palæosimia rugosidens* both found in the Chinji Zone (Sarmatian); *Dryopithecus punjabicus* and *Sivapithecus Indicus* from the Nagri and Chinji Zones; *Dryopithecus giganteus* from the Nagri Zone; *Maccus* (?) *Sivalensis*, *Cercopithecus asnoti*, and *Palæopithecus Sivalensis*,—all from the Dhok Pathan Zone (Pontian); and *Presbytis* (*Semopithecus*) *palæindicus*, *Papio subhimalayanus*, *Papio falconeri* and *simia* cf. *Satyru*,—all from Upper Siwalik Zones (upper Pliocene).—*Records of the Geological Survey of India*, XLV (1915), Part I, p. 2.

put forward by Dr. Ameghino and others, such as the so-called *Tetra-Prothomo Argentinus* (1907) attributed to the Upper Miocene, the *Diprothomo Platensis* (1909) and *Homo Pampeas* or *Prothomo* (1909), both attributed to Pliocene deposits of South America, the well-known Calaveras skull discovered in 1866 in the auriferous gravels of California (Calaveras County), and the cranial fragment and thighbone discovered by Mr. Volk in 1899 in a post-glacial deposit at Trenton in New Jersey, North America, as well as other fossil remains from the same country, such as the fossil of a human pelvic bone found by Dr. Dickenson at Natchez and the human skeleton discovered in 1902 at Sassing near Kansas City, have all been proved by Dr. Hrdlicka and other experts to belong to comparatively recent times.⁴ The alleged Pleistocene antiquity of the human remains at Vero in Florida has also not been satisfactorily made out. In fact all the supposed relics of Pleistocene man in America would appear to belong to a race anatomically as well as culturally akin to the primitive Red Indians in the stage of Neolithic culture in which they were first met with by the Europeans.

In the Dark Continent some ancient human remains are said to have been discovered in South Africa but no full and authentic accounts of them have yet appeared. Although no fossil bones of undoubted Pleistocene age appear to have been hitherto discovered in South Africa, stone implements of a type as old as the Chellian have been discovered in its ancient river deposits containing the remains of extinct fauna, and implements of the Acheulian, Mousterian and Aurignacian types are also reported to have been found. In German East Africa, Dr. Hans Reck, in 1914, discovered at Oldoway a complete human skeleton laid in a contracted posture in a stratified deposit of calcareous sand containing osseous remains of Pleistocene fauna. As the teeth were artificially pointed by having been filed in the manner of present-day Negroes of East Africa and the contracted posture suggests a burial, the Pleistocene antiquity of this skeleton is not generally admitted by experts. The geological evidence, too, is considered imperfect. Thus, Dr. Keith says, "it is very probable that the negro was fully evolved in early Pleistocene times, but the evidence

⁴ Only recently Dr. Ameghino has again reported that he has discovered a fragment of human jaw with two molars along with a stone fireplace in the ravines of Chapalmalal and Miramar where previous exploration had revealed important deposits of the Stone Age as well as fossilized bones of enormous animals of the tertiary age together with curiously wrought quartzite arrow and spear heads. A study of the morphology and fossilization of the human remains just discovered is said to prove that they belong to a type of man far older than the oldest hitherto discovered.

from Oldoway cannot be accepted as having finally proved this degree of antiquity". In 1915, an elongated large human calvaria was reported to have been found in a Pleistocene deposit at Boscop in the Transvaal.

The pre-dynastic graves of the cemetery at Naga-ed-Der in the Nile valley in Egypt have yielded remains of Proto-Egyptians along with pottery, stone vessels, beads, stone implements, and occasionally objects of gold and copper, which show that they were contemporaries of Neolithic man in Europe and would therefore be only about six thousand years old. Professor Elliot Smith who found and examined them describes the type of Proto-Egyptian represented by these skeletal remains as of slender build with an average height in the flesh of a little under 5 feet 5 inches for men and 5 feet for women. In their physical characteristics about 2 per cent. of them are said to be definitely negroid, and perhaps another 3 or 4 per cent. suggest negro admixture.⁵ As the Neolithic Briton of the river-bed type still survives, so does this pre-dynastic type of Proto-Egyptian still persist with minor modifications only. The prehistoric cemetery at Gebel Moya, south of Khartoum, between the Blue and White Niles, explored in 1910 by Mr. Henry S. Wellcome, yielded the skeletal remains of a tall Negro race resembling the modern Negroes of the valley of the White Nile⁶ not only in general physical features but in traces of the use of lip-ornaments and of the practice of knocking out the lower incisor teeth of the women. As Dr. Arthur Keith observes, "The discovery is important in this respect: it shows us that three thousand or four thousand years ago, a tall negro type was in existence and inhabited this part of the Soudan, practising the same bodily mutilations as their modern successors".⁷ Thus, these African finds do not help us in our present enquiry.

Although such vestiges of ancient man as may exist in Asia have as yet remained practically unexplored, the island of Java has yielded the most ancient osseous remains, hitherto discovered, of an ancestral type of man. Their discoverer, in a memoir published in 1894,⁸ assigned these remains to an animal having an erect attitude like man and a brain-case with mixed characters, partly simian and partly human. To this he gave the name of *Pithecanthropus Erectus*.

⁵ *The Ancient Egyptians* (Harper Brothers, 1911).

⁶ *Proceedings of the Seventeenth International Congress of Medicine* (London, 1913).

⁷ *The Antiquity of Man* (1916), p. 255.

⁸ *Pithecanthropus Erectus: eine menschenähnliche Uebergangsform aus Java* (Batavia, 1894.)

The fortunate discoverer was Dr. Eugene Dubois, a Dutch Army Surgeon, who unearthed these fossil remains from a stratum described as the uppermost Pliocene, on the east bank of the Solo or Bengawan river opposite the village of Trinil in the island of Java. This famous Trinil discovery consists of a skull-cap and a cheek-tooth discovered in 1891, and a left femur or thighbone, a second cheek-tooth and a premolar, besides a fragment of a lower jaw, found in 1892. The most marked features of *Pithecanthropus* (ape-man) are the great prominence of the supra-orbital ridges, the remarkably low and retreating forehead, a flattened skull, large molar teeth with divergent roots, and the prominent occipital protuberance. The cephalic index of *Pithecanthropus* is 70 mm. and the cranial capacity between 900 to 1,000 cc., being midway between those of a civilized European (1,550 cc.) and an anthropoid ape (500 cc.). The femur found near it in the same stratum and believed to belong to it conclusively proves the existence in the Pliocene age of a being of the genus *Homo* which had acquired the habit of normally walking perfectly erect. From the femur, which is 455 mm. in length, Dr. Dubois estimates that the stature should have been about 5 feet 8 inches (1,700 mm.) and the weight about 11 stone (70 kilograms). In the Selenka expedition to Trinil, fitted out in 1911 by Frau Lenore Selenka with assistance from certain scientific societies in Germany, a distinctly human tooth was found at Sondé, not far from Trinil, in a geological deposit earlier still than that in which the remains of *Pithecanthropus* were discovered. Thus, then, the evidence of the Trinil fossils would appear to indicate that a distinctively ancestral human or humanoid form finally emerged from the common ancestral stock of the Hominidæ and the Simiidæ, if not in the Miocene, at least in the earlier stages of the Oligocene era, and developed into the *Pithecanthropus* type by late Pliocene times. Expert opinion is, however, not unanimous as to the Pliocene antiquity of *Pithecanthropus*, for some eminent anthropologists would assign it to an early Pleistocene date. And the trend of expert opinion would seem to be in favour of regarding *Pithecanthropus* as a collateral branch from the main stock of the human family and not a human ancestor in the direct line. Dr. Keith, however, regards *Pithecanthropus* as a true survival, into late Pliocene or early Pleistocene times, of an early stage in the true and direct line of human evolution, a stage which he thinks was evolved not in the Pliocene but in the preceding or Miocene period. In Dr. Sollas' words, "in the long ancestral series which extends upwards from the apes to man he has mounted far more than half-way and only a few steps remain to separate him from the species *Homo Sapiens*, essential man".⁹

⁹*Ancient Hunters* (1915), p. 39.

In Australia, a fossilized human skull was discovered in a Pleistocene deposit of the Darling Downs, Queensland.¹⁰ The characters of this skull, known as the "Talgai skull", are such as may be expected in an early Australian type. Dr. Keith maintains that of all the existing races of mankind the present aboriginal race of Australia is the only one which could serve as a common ancestor for all modern races.

It is when we approach Europe that we meet with a growing mass of evidence of the antiquity of Man. There, systematic research has unearthed a number of osseous remains as well as industrial and artistic vestiges of early man. Although the Castenedolo remains have not made good their claim to Pliocene antiquity, the discovery made in October 1907 in Germany of a fossil human jaw or mandible discovered at Mauer first revealed the existence of man in Europe in or about Pliocene times. Expert opinion is inclined to refer the Mauer or Heidelberg man to the earliest Pleistocene rather than late Pliocene period. The discovery of this famous mandible was made by Dr. Otto Schoetensack, near the village of Mauer not far from Heidelberg in Germany, at a depth of 78 feet in a stratum which, if not actually Pliocene, is at the very bottom of the Pleistocene or Glacial series. The Heidelberg jaw, which is nearly complete with most of the teeth, is particularly remarkable for the utter absence of a chin. The teeth are altogether human but the strong grinding molars are very large, although as compared with the jaw the teeth are small. The first molar measured 11·6 by 11·2 mm. and the second molar 12·7 by 12 mm. Dr. Keith, as a result of the comparison of the Heidelberg mandible with that of a female orang-outang, of an Australian native and of a Neanderthal specimen from Spy, and a comparison between the palate of the Heidelberg man and the Neanderthal variety discovered at La Chapelle-aux-saints (see *infra*), has come to the conclusion that, "in the Heidelberg mandible we find the usual Neanderthal features of the chin; only they are more primitive, more simian in their development". The area represented by the outer surface of the ramus of the Heidelberg mandible is 34 cm. while the corresponding area in the Australian measures 22 cm. and in the modern European mandible 18 cm. These measurements indicate the extraordinary strength of the masticatory system of the Heidelberg man. The alveolar border, on which the teeth are implanted, is prolonged far forwards and the chin recedes almost as in an ape,

¹⁰ Sollas considers the Talgai skull to resemble the Piltdown skull (*Eoanthropus dawsonii*.)

the difference being only in actual shape, particularly in the form of the coronoid process. The palate is human and not simian. Although the lower part of the symphysis encroaches, as in the ape, on the floor of the mouth, the faculty of speech appears to have been partially developed.

The most remarkable discovery in Europe of an ancient human skull with a portion of the lower jaw was made in the autumn of 1911 by Dr. Charles Dawson at Piltdown near Fletching in the county of Sussex in England. Next to that of *Pithecanthropus*, it is the most primitive and ape-like human skull yet discovered. It is believed to have been that of a woman. During 1912, Dr. A. Smith Woodward, the Keeper of Geology at the British Museum, in company with Dr. Dawson made a thorough search of the bed and discovered fragments enough to build up an almost complete skull. And a paper by Drs. Dawson and Woodward describing the skull was read before the Geological Society of London in December 1912. From this paper we learn that the cranial capacity of the skull is about 1,070 cc. and the bones of the skull are nearly twice as thick as those of a modern skull. The skull has the vertical forehead of a modern man with practically no median crest. Low and narrow in front, the skull becomes widest and highest towards the back, so that although it looks somewhat like a modern human skull from the front, it presents a simian aspect at the back. Another remarkable feature is the short bony floor in front of the lower jaw. *Eoanthropus* (lit., dawn-man) balanced his head like a modern man and had the same flat-sided head-form. But the size of his brain is not more than two-thirds of that of a modern man. Although Dr. Smith Woodward estimated the cranial capacity of *Eoanthropus* at only 1,070 cc., Dr. Keith estimates it at 1,415 cc. and the cephalic index at 78. The dimensions of the first and second molar teeth are respectively 11.5 by 10 mm. and 12 by 10 mm. Dr. Woodward opines that the Piltdown skull proves the existence of a real intermediate form, a true link between man and the ape. The Piltdown race, as we have seen, tends towards round-headedness, or brachycephali, which is found not only in anthropoid apes but also in some highly evolved races of man. Whereas in the Heidelberg mandible human features have begun to appear, in the Piltdown mandible a simian conformation is still preserved. Although the molar teeth are human, the canine teeth are more ape-like than any other human canine. After a most exhaustive survey (extending to over more than 200 pages of octavo) of the structural features of *Eoanthropus*, Dr. Keith thus sums up his conclusions: "So far as the face is concerned we can say with certainty that the forehead of *Eoanthropus* was well formed. It

was high, prominent, and of a depth equal to that of a modern human skull of average dimensions. The nasal bones were shaped exactly as in negroid races, and we infer that the nose itself must have been not unlike the broad, flat organ seen in certain primitive living races. The dimensions of the face—its length and width—did not differ from the corresponding facial measurements of other primitive forms of men. Although the front teeth, the incisors and canines, exceeded in size those of any known form of man, and although the palate must have been of very great length, yet the degree of prognathism was not beyond the limits known to occur in living races. The forward extension of the frontal region marked the great size of the jaws. But if this was the effect of the frontal projection, the receding simian formation of the chin must have given the lower part of the face a conformation not unlike that seen in anthropoid apes".¹¹

In the gravel, in close association with the skull, were found mammalian teeth of the Pliocene age and primitive shaped pre-Chellian or rather pre-Strepyan flints (eoliths) of the lower Pleistocene. Although the comparatively unworn condition of the human remains is said to point to a Pleistocene age and its association with older mammalian relics such as the *Stegodon*—a variety of elephant whose remains are known to occur in Pliocene deposits in India, but hitherto unknown in Europe—to have been merely accidental, the similar staining of the human skull and the Pliocene relics found in association with it, is by some authorities maintained as sufficient proof for the older date. Dr. Keith says, "I am of opinion that future discoveries will prove that the remains found at Piltdown represent the first trace yet found of a Pliocene form of man".

These are the only fossil evidences, few and fragmentary, hitherto discovered of the presence of man or, rather, sub-human precursors of man either as early as the latest Pliocene or the earliest Pleistocene age. And of these, the more primitive and perhaps geologically more ancient type hails from Asia and the comparatively less primitive forms from Europe. Unlike later human fossil finds, most of which were apparently interred in the places where they were discovered, the three most ancient finds—the Trinil fragments, the Piltdown skull, and the Heidelberg jaw—were apparently scattered fragments of skeletons of individuals who had been either washed away or drowned and dismembered in a stream.

It is mostly, again, in Europe that the skeletal remains of the more developed human type which anthropologists have agreed to call *Homo primigenius* have been discovered.

¹¹ *The Antiquity of Man* (1916), p. 496.

The most important, if not the first, discovery of the kind was made in 1856 in a Mindel-Riss glacial deposit in the Feldhofen cave situated at the entrance of a ravine called Neanderthal not far from Düsseldorf in Rhenish Prussia. The remains consisted of a skull cap, two femora or thigh-bones, two humeri or upper bones of the arms, a shoulder-blade, a collar-bone, besides fragments of ribs. The discoverer, Dr. Fuhlrott, in collaboration with Professor Schaffhausen, published an account of the remains in 1857. The skull was elliptical in shape, and was characterized by its great size and excessive thickness, its snout-like type of face due to excessive prognathism, a low retreating forehead and wide nose, excessive growth of the brow ridges, the glabella and supra-temporal ridges,—these together forming a sinuate prominent ridge which extends continuously from one temple to the other,—excessive development of the frontal sinuses, and a great projection of the occipital region. The jaws are large and parallel-sided, the lower jaw being particularly heavy and massive, and conspicuous for the absence of a chin. The incisors are small, the canines very large, and the premolars very oblique. Among living races, something approaching this swollen frontal torus of the Neanderthaler is found only among the Australian natives who, however, do not show the corresponding depression or frontal fossa which runs parallel with the torus in the Neanderthal skull. The frontal lobes of the brain in which the faculty of speech is believed to be lodged are well developed. The cranial capacity of the Feldhofen skull as estimated by Huxley was 1,330 cc. and the cephalic index about 72. This is the type specimen after which the race has been named *Homo Neanderthalensis*. Neanderthal man is known from his cultural associations as Mousterian man.

Several fossil remains with similar osteological characters have been discovered at various localities in Pleistocene strata. The more important amongst them are the two human skeletons unearthed in 1886 by MM. Lohest and dePuydt at Spy in the province of Namur in Belgium, with cephalic indices of 70 and 75 respectively; the famous Naulette jaw discovered by M. Edouard Dupont in 1885 in the Trou de la Naulette in Belgium; the lower jaw discovered in 1895 in a cave at Isturitz (Basses-Pyrenees); another lower jaw discovered in 1889 in the cave of Malarnaud in Ariège at the foot of the Pyrenees; certain fragmentary bones of the face found by M. Edouard Piette in a cave near Gourdan in the valley of the Cean (a tributary of the Dordogne); three fragments of jaws discovered by M. Favraud in a Mousterian stratum in the department of Charente in France; the buried skeleton of a man with unusually large teeth, having their roots

distinct and not conjoint, discovered in 1908 by Dr. Hauser at Le Moustier in the Dordogne district in France, and known after him as *Homo Mousterensis hauseri*; and the skeleton of a chinless old man with a cephalic index of 75, a cranial capacity of 1,600 cc., and a stature of 5 feet 4 inches (1,600 m.), buried in the rock-shelter of La Chapelle-aux-saints in Correze in the South of France, discovered by M. Peyrony in August 1908, and the skull discovered by him in February 1909 and other skeletons exhumed by him at La Ferrassie, in Dordogne, in September 1909; two skulls found at La Denise on the Upper Loire; over two hundred fragments of human skeletons representing at least ten individuals of both sexes found in a deposit near the town of Krapina in Croatia, discovered between 1899 and 1905 by Professor Gorjanovic-Kramberger and characterized by wide crania, very large brow-ridges, flattened and retreating foreheads, massive jaws and remarkable size of the molar teeth and curvature of the canine teeth, and feeble development of the chin; the skeleton of a Neanderthaler, supposed to be a female with a cephalic index of 67, a cranial capacity of 1,350 cc., and a stature of 5 feet (1,500 m.), who probably met her death by drowning, discovered at La Quina (Charente) in France; a broken skull of a child from Pech de l'Aze; fragments of a lower jaw found in 1908 in the floor strata of a cave at Schipka, and another at Ochots, both in Moravia; the nine fossil teeth of a young man discovered by Dr. Marett near S. Brelade's Bay in Jersey, resembling those of Krapina but with fusion of the roots of the molar teeth; the skull and other bones discovered at Brück near Prague in Bohemia; and the Forbes Quarry skull with its enormous eye cavity and low flattened cranial curve found in Gibraltar as early as 1848 but only lately recognized as belonging to the Neanderthal type, although the brain with a capacity between 1,200 to 1,300 cc.¹² is smaller than that of any other Neanderthaler so far discovered. These fossil remains of the Neanderthal man were found mostly in Central Europe. It is interesting to note that the Düsseldorf skull is dolichocephalic or long-headed, the Krapina skulls are brachycephalic or narrow-headed, and the Gibraltar skull is mesocephalic or medium-headed. Thus, as in modern man (*Homo sapiens*) there are distinct races or varieties, so also Neanderthal man (*Homo primigenius*) appears to have comprised different varieties with different types of head-form, although the predominant type was probably dolichocephalic. A striking feature of all Neanderthal skulls is their peculiarly depressed platycephalic form—a feature which, as Dr. Keith tells us, "must have given the Neanderthal man in life the peculiar appearance of having the

¹² Dr. Keith estimates it at 1,200 cc., Professor Sollas at 1,260 cc. and Professor Boule at 1,296 cc.

hinder part of his head buried, apparently, in a thick, bull-like neck". Whereas the modern skull is flattened from side to side, the Neanderthal skull, Dr. Keith says, "gives us the impression of being compressed from above downwards into a bun-like form." "In size of brain, the Neanderthal man was not a low form". Objects found in association with some of his osseous remains indicate that Neanderthal man had fire at his command, buried his dead, and manufactured flint implements.

In England, the Mousterian man of the Neanderthal type in the Middle Pleistocene period is represented by the Kent cavern jaw. But the well-known Galley Hill skull (cephalic index 64.5) and the Bury St. Edmunds skull (c.i., 80) appear to differ from the type and to belong to a less primitive type to which may also be referred such specimens as the Combe Capelle man (with a cephalic index of 65.7, cranial capacity of 1,440 cc., and stature of a little over 5 feet 2 inches, or 1,550 m), and the Brunn (c. i., 66), Clichy (c. i., 67), Solutre (c. i., 90), Cromagnon (c. i. 73.76) and Grimaldi (c. i. 76.26) men—all characterized by a diminished brow-ridge, more straight and slender limb-bones, greater curve in the arc of the brain-case, a vertical forehead, and a slight projection of the chin.¹³ Although a sloping chin, deep and powerful jaws, excessive prognathism, and other features, all give a brutal savage expression to the Neanderthal type of face, there can be no doubt that the short but sturdily built Neanderthals formed a distinct type of mankind—the most primitive and earliest generalized wide-ranging type hitherto known. Some prominent anthropologists hold, that the Neanderthal or *Homo primigenius* might have been a lingering representative of his kind in Europe which either died out or was conquered by and absorbed in the higher type of humanity represented by the Aurignacians and their descendants or successors, the Magdalenian or Cromagnon race, of possibly the Third Inter-glacial age and certainly the Fourth Glacial and even Post-Glacial ages. The names Aurignacian and Magdalenian, it may be noted, are derived from their cultural associations. Others, again, would regard *Homo primigenius* as only an older primitive variety or race of *Homo sapiens*, and not a distinct species of the genus *homo*. Thus, Obermaier, on the principles of Zoological classification, terms the Neanderthal man as *Homo*

¹³ This later primitive variety of mankind, with much less simian features, lighter build, vertical forehead, less projecting brow-ridges and more well-formed chin than the Neanderthal, known by his cultural associations as Aurignacian, is classified by Duckworth on anatomical evidence as *Homo recens (fossilis)* which he regards as a subdivision of the same group to which *Homo primigenius* belongs.

sapiens var. *primigenius* as distinguished from modern man whom he classifies as *Homo sapiens* var. *recens*.¹⁴

Indeed, the precise relations of *Pithecanthropus Erectus*, *Eoanthropus Dawsonii* and *Homo Heidelbergensis* to one another and to *Homo primigenius*, and the relations of the last three to *Homo sapiens* or modern type of man are still moot questions. Two skeletons of a woman and a boy, perhaps mother and son, discovered at a great depth in the *Grottes des Enfants* or *Grottes des Grimaldi* near Mentone, in a contracted position with the right arm of the boy round the woman's femur are described by Dr. Verneau as belonging to a race intermediate between the Neanderthal and the Cromagnon races. These skeletons would appear to be those of a short "Negroid" race with whom the tall, fine Cromagnon race appear to have been acquainted. Possibly the Grimaldi race was an overflow from North Africa. Although their marked prognathism, large teeth, feebly developed chin, long and slender lower limbs and relatively long forearm and shin-bones are taken by Dr. Verneau and others to indicate negroid affinity, Professor Gaudry is impressed with their resemblance to the Australian aborigines. And in this connexion it is interesting to note that about two feet higher up in this Mentone debris a skeleton of the Cromagnon type was found, lending colour to the theory that while a higher race was being developed, individuals of an older and lower race still lingered in Europe. The Cromagnon race appear to have been evolved from the Loess-hunters¹⁵ or Aurignacian race of the third Inter-glacial age. With the tall Cromagnon race, possessing remarkable artistic feeling and mechanical skill as displayed in their rock paintings and engravings, we reach the stage of *Homo sapiens*, a type practically indistinguishable in all essentials from the highest modern type of man. The osseous remains of the Neanderthals are found mostly in the Middle Palæolithic period, covered by the Middle-Riss or second Inter-glacial, and the Riss or third glacial deposits of the Pleistocene period, although a few late Neanderthals appear to have lingered on till the middle of the third Inter-glacial (Riss-Würm) phase along with the Aurignacian loess-hunters and the Cromagnon reindeer-hunters. These latter were both long-headed or dolichocephalic races.

Thus, by the end of the Pleistocene period, the whole habitable world would appear to have been occupied by the generalized

¹⁴ *Der Mensch der Vorzeit* (1912), p. 365.

¹⁵ In the Riss-Würm or third Inter-glacial age in many parts of Europe there were vast expanses of steppe in which either the floods following the third glacial phase or dust-storms formed peculiar deposits of clay known as the ancient "loess" or "limon gris". Considerable number of skeletons of the Aurignacian type have been discovered in these loesses, and hence the Aurignacian race is often described as *Loess-hunters*.

precursors of the present races of man. With the commencement of the post-glacial times that followed we first find in Central Europe a distinctly brachycephalic people represented by the Furfooz skulls. It is interesting to note that the round barrows of the Neolithic age of Europe are generally found to contain the remains of round-headed or brachycephalic and the long barrows those of long-headed people. All these later races, however, do not concern us at this stage.

A consideration of the osteological characters of the more important earlier skeletal remains of man that I have briefly referred to, would seem to indicate that by the latest Pliocene or earliest Pleistocene times, the human line or lines had long diverged from the simian line of descent—long enough to produce types like *Pithecanthropus erectus*, *Homo Heidelbergensis* and *Eoanthropus Dawsonii*. And these types again would seem to indicate the former existence of earlier ancestral stages in human evolution. This inference seems to be corroborated, as we shall presently see, by other evidence.

Although the evidence of the osseous remains of man's antiquity does not take us much further back than the beginning of the Quaternary era, or at most, the close of the Tertiary, there is another class of evidence which, if genuine, would appear to shed a dim uncertain light a little further back into the darkness of Ancient Time. This evidence consists of a class of supposed human artifacts known as eoliths, the earliest and rudest stone implements attributed to man and his semi-human precursors. These have been found in geologic deposits as old as the Miocene and even perhaps the Oligocene, and appear to have lingered on till the earlier phases of the Pleistocene, when they were superseded by well recognized palæoliths. Although not long ago the human origin of eoliths was a very controversial question, the preponderance of present authoritative opinion would seem rather to incline in favour of human agency in their manufacture, such experts as Rutot, Reid Moir, Ray Lankester, Klaatsch, Verneau and Harrison having pronounced in its favour, although authorities like Sollas, Cummont, Breuil and Boule still doubt the human origin of these eoliths and Rostrocarinate flints. The opponents of the eolith theory would attribute their production and simulation of design to the chance action of the moving water of river and torrent, of sea-waves and coast-ice, and to natural fracture due to accidental pressure, such as that of a cart-wheel, movement under pressure of superincumbent strata or glaciers, and to soil-creep. Such causes as the above, they point out, may produce all the

characters supposed to indicate intentional flaking. The advocates of human workmanship of the eoliths, on the other hand, point out that from the beginning of the Pleistocene epoch and possibly from the Pliocene, there is undoubted geological evidence of the use of palæoliths with definite and suitable shapes, and it is only reasonable to infer that Pleistocene man could not have suddenly developed the art but must have taken a long time in acquiring it, and that the eoliths would be just the products of this period of apprenticeship in the art of tool-making; for, as M. Rutot observes, the eolith-maker was either not yet able to foresee the tool he required or, at any rate, he could not get it with certainty, and the immediate precursor of *Homo sapiens* would presumably have manufactured them. The lingering use, even at this day, of stone implements of the eolithic type among primitive tribes, such as the Seri Indians and the Andaman Islanders, is further pointed out as a confirmation of the Eolith theory. The reported similarity in form of all implements of the eolith type wherever they occur and their rough though much-worn chippings are also considered to indicate human design.

It may be noted, in passing, that M. Rutot has sub-divided the "Eolithic Period", beginning from the junction of the Pliocene and Pleistocene ages, successively into Reutelian, Mafflian, and Mesvinian industries. Similar implements of supposed human origin have, however, been discovered in still lower strata. The most important of such finds of supposed eoliths are those of the Middle Oligocene at Boncellas in France discovered by Rutot and De Munck; of the Upper Oligocene at Thenay by the Abbé Bourgeois; of the Miocene at Duam and Puy Courney in France by M. Rames, and at Otta Tejotal in Portugal by Sr. Carlos Ribeiro; of the Early Pliocene at several sites in or near Ipswich by Mr. Reid Moir; of the Mid-Pliocene on the North Downs of the Kent plateau by Mr. Harrison; of the Upper Pliocene in the Norwich Crag by Dr. W. G. Clarke, at Salisbury by Dr. Blackmore, in the Cromer Forest by Lewis Abbott, and at Boncelles by M. Rutot. Outside Europe, eoliths are reported to have been found in Egypt, South Africa and Burma. We hope some day we may light upon some of these problematical eoliths in this Province, as we have already found some undoubted palæoliths and numerous neoliths in Chōtā Nāgpur and the Santāl Parganas. The evidence of eoliths, if finally accepted, will lend strong support to the inference, rendered probable by other considerations already mentioned, that semi-human precursors of man whom I have called 'Pre-Men' lived as far back as the Upper Oligocene, if not earlier. Some experts, however, do not admit that there is satisfactory evidence that the Hominidæ separated from the Simiidæ earlier than the Miocene. The direct skeletal evidence—the order of succession

in time of fossil remains of man and the apes—only goes to show that *Homo sapiens*, or man in the modern and strictest sense, was fully evolved in Pleistocene times; but as we trace him backwards into the past by the stratigraphical method of Geology and Palæontology, we find in his place Pliocene forms which have been supposed to be specifically distinct, whereas in the Miocene and the Oligocene ages we meet with no fossil remains which may be definitely attributed even to the genus *Homo*.

I have, so far, referred to the earliest stages of man's evolution with reference to the geological time-scale, and not in terms of years, centuries and milleniums. In fact, the geological time-scale is essentially a relative one and gives no indication of absolute duration in years. How difficult it is to translate the geological time-scale into years may be judged from the fact that the age of the earth has been variously estimated by different authorities at from a minimum of twenty millions or two crores to a maximum of seven hundred millions or seventy crores of years.

These widely divergent estimates are due to altogether different bases of calculation adopted by different authorities: One estimate is based on the time required for the deposition of the present thickness of sedimentary rocks, such time being calculated at the approximate quantity of sediment annually carried into the sea by the great rivers of the present day; a second estimate is based on the time required for the accumulation in the sea of its total quantity of salt as calculated by the amount of sodium received annually by the sea through the denudation of the igneous rocks; a third estimate is based on the age of the sun as deduced from its present temperature and the rate of loss of heat by the sun, one of the latest methods is based on the time required for the disintegration of the elements in the uranium-bearing radio-active minerals occurring in rocks of the different geological systems.

The results thus arrived at were recently compared and combined by the late Joseph Barrell of the Indian Geological Survey with those obtained from other geological methods of determining the age of the fossiliferous rocks, and the following minimum and maximum ages were estimated for them:—for the Palæozoic system, from a minimum of 360 millions to a maximum of 460 millions; for the Mesozoic, from 135 millions to 175 millions; and for the Cainozoic, from 55 to 65 millions of years, thus making a total of from 550 to 700 millions for all the three. Maximum and minimum ages have been similarly calculated for the different systems of each period. Thus, for the Recent and Pleistocene systems has been assigned a duration of 1 to 1½ million years, for the Pliocene 6 to 7½, for

the Miocene 12 to 14, for the Oligocene 16, for the Eocene 20 to 26, for the Cretaceous from 65 to 85, for the Jurassic from 35 to 45, and also for the Triassic from 35 to 45, for the Permian and Carboniferous together from 110 to 130, for the Devonian 50, for the Silurian 40, for the Ordovician from 90 to 130, and for the Cambrian from 70 to 110 millions of years. According to this calculation, trilobites appeared between 550 and 700 million years ago, the first fish between 350 and 400 million years ago, the birds about 150 million years ago, and the mammals, though they first appeared at about the same time as the birds, reached their maximum development in the Miocene and Pliocene periods between 5 and 10 million years ago.¹⁶

As for man, if the human, or rather humanoid, stem be taken to have branched off from the common anthropoid ancestral stock at about the middle of the Oligocene era, an antiquity of from 27 to 31 million years might, on this calculation, be claimed for the earliest members of the human line of descent. If *Pithecanthropus* is assigned a place not earlier than at the top of the Pliocene or bottom of the Pleistocene age, and the Neanderthal man at the middle of that age, the antiquity of the former may, on this basis, be estimated at from 1 to 1½ million years and of the latter from half to three-quarters of a million. As for the vast intervening period between the first divergence of the humanoid stem from the ancestral stock and the date of *Pithecanthropus*, the presence of supposed eoliths, as early as the Oligocene age, as I have already said, forms the only direct though uncertain evidence we at present possess; and these, as we have seen, would push back the antiquity of *Pre-Man* to between 35 and 39 million years ago.

Almost incomprehensible as this immense period would appear to us, Man, as Tennyson poetically puts it, is as yet in the Red of the Dawn. So long as we find—

Man with his brotherless dinner on man in the tropical wood,
Priests in the name of the Lord passing souls through fire to the fire,
Head-hunters and boats of Dahomey that float upon human blood,

man may yet be said to smell of the beast. Even higher races cannot altogether escape from occasional moods of the tiger and the ape. As Tennyson says, with the—

Godless fury of peoples, and Christless frolic of kings,
And the bolt of war dashing down upon cities and blazing farms,
Babylon was a child new-born, and Rome was a babe in arms;
And London and Paris and all the rest are as yet but in leading strings.

¹⁶ Vide Dr. H. H. Hayden in the *Journal of the Asiatic Society of Bengal*, 1919, p. xiv. *et seq.* The estimates of geological periods generally accepted are, however, smaller. Thus, according to Sollas, the duration of the Eocene age was 1,200,000 years, of the Oligocene 1,200,000 years, of the Miocene 900,000 years, of the Pliocene 500,000 years, and of the Pleistocene and Recent ages 400,000 years.

There is, however, no cause for despair. Anthropology bids us hope for the best. The yelp of the beast will be quiet at last, and the man within us shall be free.

For, Man is yet but in the making. In the words of the poet—

If twenty millions of summers are stored in the sunlight still,

We are far from the noon of man, there is time for the race to grow.



LECTURE III.

The Evolution Theory.

The principle of Evolution, as I said in my first lecture, forms the basis of Anthropology as of other Biological sciences. Anthropology proceeds in its investigations with the assumption of the basal idea of evolution as a fact, and seeks to discover, if possible, the steps of adaptation, the factors of habit, heredity or environment that have led to man's physical and psychical evolution and his differentiation into races and sub-races.

A thorough grasp of the doctrine of evolution, with its central problems of variation, heredity, and selection, is therefore essential for the student of Anthropology. I shall accordingly attempt in the present lecture to briefly trace the development of this fundamental principle of our science, and the result of modern research on the nature and relative importance of the factors which have contributed to bring about the orderly progressive change from lower to higher forms of life which constitutes biological evolution.

Creation Theory and Evolution Theory. The older theory of "special creation" of every species and definitely fixed types of life which obsessed thinkers of earlier generations was finally replaced in the nineteenth century by the publication, in 1859, of Darwin's *Origin of Species*. But Darwin was by no means the discoverer of the law of evolution.

Ancient Hindu Idea of Evolution. In our ancient Sanskrit literature we meet with definite references to the idea of successive evolution of organic forms. Thus the *Bṛhad Vishnu-Purāṇa* in referring to the eight millions and four hundred types or forms through which the soul has to pass in its upward growth, describes the successive organic forms as follows :—

*Sthābaram binsaterlaksham jalajam nabalakshakam,
Kurmāschā nabalaksham cha dasalaksham chu pakshinah,
Trimśalaksham paśunām cha chaturlaksham cha bānarāk,
Tato manusḥyatām prāpya tatah karmāṇi sādḥayet.*

"Two millions of immoveable (plant or vegetable) forms, nine hundred thousand aquatic forms, nine hundred thousand turtle (or reptile) forms, one million bird forms, three millions of quadruped forms and four hundred thousand simian or ape forms. Then [the soul] attaining the human form performs work (i.e. perfects itself by action)." Here, the idea is the same, although the point of view and the mode of presenting it are somewhat different. There is here a clear perception of the evolution of organized life successively through reptilian, mammalian and simian forms to the human form. And the same idea is repeated in some other Purāṇas. Thus the theory of evolution, in its broad though perhaps vague outlines, was not unknown to ancient Indian thinkers.

The history of the development of the scientific theories of evolution in Europe may be divided into three periods. The first period is that of the Pre-Darwinian evolutionists among whom Lamarck is the best known, the second period is that of Darwin and his followers, and the third that of the Post-Darwinian evolutionists like Mendel, De Vries, Morgan and Bateson.

First Phase: Pre-Darwinian Evolutionists.

In ancient Europe, vague anticipations of biological evolution may be traced in the writings of some of the early Greek thinkers such as Heraclitus (*circa* 540-575 B.C.), Empedocles (*circa* 490-430 B.C.), Democritus (born *circa* 470 or 460 B.C.), Aristotle (384-322 B.C.), Lucretius (c. 98-55 B.C.), and a few others. The Neo-Platonists such as Plotinus (A.D. 204-270), though conceiving of the origin of the world as a necessary physical effect and not the result of volition, follow Plato (*circa* 427-347 B.C.) in representing the world-process as a series of descending steps, each less perfect than its predecessors since it is further removed from the first cause.

Nor do the Gnostics with their cosmic theory of emanation and the early schoolmen of the Middle Ages who, for the most part, sought to combine the Aristotelian teleological view of nature with the Christian idea of the Deity and His relation to the world, make any advance towards a more accurate and scientific explanation of the world-process. Among the later schoolmen, a crude idea of physical evolution appears in the speculations of Duns Scotus (A.D. 1265 or 1275—1308) whose dialectical ingenuity won for him the title of Doctor Subtilis, but from whose name, curiously enough, the

**Early
European
ideas of
evolution.**

**European
ideas of
evolution in
the Middle
Ages.**

English word "dunce" is either wittily or wilfully derived. Duns Scotus forcibly put forward the idea of a progressive development in nature by means, however, of a process of determination,—his "materia primo-prima" or the original substance of the world being the immediate creation of the Deity.

Coming down to more recent times, a little further approach towards the modern idea of the evolutionary nature of the world process—the idea of a graduated scale of beings or succession of stages, of which the lower form the conditions of the higher—appears in the speculations of such German thinkers of the eighteenth century as Leibnitz (1646-1716) and his followers, Herder (1744-1803), and, to a less extent, Lessing (1729-1781);—Schelling (1775-1854) and his followers Lorenz Oken (1779-1851) and Heinrich Steffens (1773-1845)—the author of a work called *Anthropologie*;—and Emanuel Kant (1724-1804) and his follower Arthur Schopenhauer (1788-1860). In most of these writers, however, although existence is represented as "becoming" or a process of evolution, their idea of evolution appears as a more or less metaphysical as distinguished from a scientific one. Among these German thinkers special mention must be made of the great embryologist Karl Ernest Von Baer (1792-1876) who first discovered the human ovum, enunciated the "law of corresponding stages" in the development of vertebrate embryos, and recognized in the law of development the law of the universe as a whole. Although Von Baer asserts that "the law of growing individuality is the fundamental thought which goes through all forms and degrees of development and all single relations", he could not rid himself of the "telic" idea and the archetypal theory which it involved, and thus could not accept the theory of unbroken descent with modification, when it was propounded by Darwin and Wallace in 1858.

In advance of the scientific thought of his country was the German anatomist and physiologist Casper Friedrich Wolff (1733-1794), justly called the founder of modern embryology in Europe. His researches mark a decided advance in the evolution theory. He largely anticipated the modern conception of embryonic layers and is said to have even foreshadowed the cell theory; and his researches on the development of the alimentary canal in the chick first clearly established the theory of progressive formation and differentiation of organs characteristic of the adult from a relatively homogenous rudiment. This theory known as the *Epigenesis* theory, and enunciated in his *Theoria generationis*, published in 1759, marks a new era in the European idea of Evolution which was hitherto crudely conceived of as a simple growth

in size and unfolding of organs all previously existent in the germ. This principle of *epigenesis*, it may be noted, was first suggested by Aristotle in the case of the higher animals and advocated in the seventeenth century by William Harvey, the famous discoverer of the circulation of the blood.

In India, it is worthy of note that the Science of Embryology, had already reached an advanced state of progress in the time of Charaka¹ and his remote predecessor Suśruta² as will be seen from a luminous account of it given by our distinguished savant Dr. Brajendra Nath Seal in his monograph in the second volume of Dr. (now Sir) P. C. Ray's *Hindu Chemistry*. Charaka and Suśruta, however, following Dhanvantari, hold that "the foetus or rather the fertilized ovum, develops by *palingenesis* (instead of *epigenesis*) ; in other words, all the organs are potentially present therein at the same time and unfold in a certain order". Charaka explains the development by the simile of the sprouting bamboo seed and the mango-blossom (*baṁsāṅkurabat chyūtaphalabatcha*). "As the sprouting bamboo-seed contains in miniature the entire structure of the bamboo, as the mango-blossom contains the stone, the pulp, the fibres, which appear separated and distinct in the ripe fruit, though from their excessive minuteness they are undistinguishable in the blossom, even such is the case with the fertilized ovum."

It is among the French thinkers of the eighteenth century that advancing physical speculation as to the origin of the world as a natural process first becomes a marked feature of the history of thought. And such writers as Baron d'Holbach (1723-1789) in his *De la Nature*, and his contemporary Jean Baptiste Rene in his *Le Systeme de la Nature*, and Benoit de Maillet in his *Tellamed*, printed in 1735 and published in 1758, sought to provide a consistent materialistic view of the world and its processes. While Rene worked out a conception of a gradation in organic existence, connecting this with a general view of nature as a progress from the lowest inorganic forms of matter up to man, and Baron d'Holbach conceived of man as a product of nature that had gradually developed itself from a low condition,—De Maillet had a definite conception

¹ According to the French orientalist Sylvain Levi, Charaka was the guru of king Kanishka who flourished in the second century A. D. and according to Dr. Hoernle and Dr. Bühler he lived between 400 A. D. and 500 A. D.

² Suśruta is spoken of in the Mahābhārata as the son of Viśvāmitra and was thus regarded as of mythical origin even in the fifth century.

of the plasticity of living things and the production of existing species by the modification of their predecessors. More well-known is the great French naturalist George Louis Leclerc, comte de Buffon (1707-1788), who first discredited the older theory of special creation and permanent stability of species on which the great systematist Linné had based his important "*Systema naturæ*". Buffon hinted that their general resemblance suggested a possible common ancestor for horse and ass and for ape and man; but as the Bible affirms the contrary, he took the precaution of saying, "Of course the thing cannot be"; and later, in 1751, he was constrained by the Sorbonne to recant his geological heresies in these words:—"I declare that I had no intention to contradict the text of Scripture; that I believe most firmly all therein related about the Creation, both as to order of time and matter of fact".

A passing mention should not be omitted of the naturalist Charles Bonnet (1720-1793), a lawyer by profession, who was born of a French family driven into Switzerland by religious persecution in the sixteenth century. He set forth in his popular work *Contemplation de la nature*, published at Amsterdam in 1764-1765 and translated into German, Italian, English and Dutch, the theory that all beings in nature form a gradual scale rising from lowest to highest without any break in its continuity. And in his *Palingenese Philosophique*, published at Geneva in 1769-1770, he treats of the past and the future of living beings, and supports the idea of the survival of all animals, and the perfecting of their faculties in a future state. Although in his earlier writings Bonnet advocated the *Palingenesis* theory of evolution which supposes every germ to contain in miniature all the organs of the adult, and affirmed that, before fecundation, the hen's egg contains an excessively minute but complete chick, in his later writings he modified this view and admitted that a "germ" need not be an actual miniature of the organism, but that it may be merely what he calls an "original pre-formation" capable of producing the latter. This idea of evolution, it will be seen, is hardly distinguishable from "Epigenesis". But Bonnet at the same time strongly held fast by what he calls his "emboitement" theory that all living things proceed from pre-existing germs, and that these contain, one enclosed within the other, the germs of all future living things. Thus, with Bonnet, "evolution" and "development" remained synonymous terms, and the growth of an organic being was simply the expansion of that which was invisible into visibility. Bonnet was supported in this view of evolution by the authority of the great Swissman, Allrecht Von Haller (1708-1777), the first physiologist of his age; and it may be noticed that Cuvier substantially adopted this view and Buffon held nearly the same views as to the nature of the germ.

Thus in spite of Wolff's theory of epigenesis promulgated in 1759 and supported by Oken and Meckel, the theory of evolution by expansion or development practically held its ground until the beginning of the nineteenth century when the great French naturalist, Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck (1744-1829) first definitely propounded the theory of evolution based on the idea of the gradual development under the stimulus of special use for generations. He attributed the appearance of organic life in the shape of primordial germs or monads to spontaneous generation resulting from such agencies as heat and electricity causing in small gelatinous bodies an utricular structure and inducing a "singular tension", a kind of "erethisme" or "orgasme" as he called it. According to him, species were not fixed, the more complex form having been developed from pre-existing simpler forms. Altered wants lead to altered habits, and the modification, development or dwindling of those previously existing. Thus the neck of the giraffe has become elongated through the special use which involves its being stretched continually to reach the foliage of trees, and the hind limbs of the whale have gradually dwindled through disuse. This adaptation of structure to function is, according to Lamarck, a factor of inheritance and consequently of evolution. Thus, species and races were developed mainly by the accumulation of the effects of use and disuse, and, subsidiarily, by such other physical conditions of life as crossing; and Man is the result of the slow transformation of certain simian forms. Lamarck first published his views in 1801, and elaborated his system of evolution through heredity and adaptation in his *Philosophie Zoologique*, published in 1809; and in the introduction to his *Histoire naturelle des animaux sans vertèbres*, published in 1815, he formulated his four laws³ to account for the whole organization of animals and the formation of different organs. Whereas the older advocates of evolution looked for the causes of the process solely in the

³ Lamarck's four laws are:—

- (1) "Life by its proper forces tends continually to increase the volume of every body possessing it and to enlarge its parts, up to a limit which it brings about."
- (2) "The production of a new organ in an animal body results from the super-vention of a new want continuing to make itself felt, and a new movement which this want gives birth to and encourages."
- (3) "The development of organs and their force of action are constantly in ratio to the employment of these organs."
- (4) "All which has been acquired, laid down, or changed in the organization of individuals in the course of their life is conserved by generation and transmitted to the new individuals which proceed from those which have undergone those changes."

influence of varying external conditions such as climate and hybridization upon living forms, Lamarck first introduced the conception of the action of an animal upon itself as a factor in producing modification. According to Lamarck's theory, all variations whether resulting from the direct action of environment or from use and disuse, are what we now call acquired characters; and all acquired characters are inherited. While the type is preserved by heredity in successive generations, adaptation to environment modifies the species by alteration of habits and the use and disuse of different organs. Although the crude Lamarckian conception of the transmission of individually acquired characters promises little chance of revival, the new school of biologists⁴ anticipate the discovery that individual experiences count for something in evolution. Among Lamarck's distinguished contemporaries, while Baron Cuvier (1769-1832) who divided the animal world into four great "embranchments" or groups each corresponding to an independent archetype in the mind of the Creator, was a powerful opponent of his theory, Geoffroy Saint-Hilaire (1772-1844) was a staunch supporter. St. Hilaire believed in the mutability of species, but ascribed the main influence in its evolution to the *monde ambiant*. He accounted for the discontinuity of species by the theory that the environment could produce sudden changes in the specific character of the embryo.

The theory of natural selection or survival of the fittest was first suggested by William Charles Wells in 1813, and further elaborated by Patrick Mathew in the appendix to a book on naval timber and arboriculture published in 1831. But their suggestions remained unheeded until Darwin and Wallace independently discovered and formulated the theory. The German naturalist, Gottfried Reinhold Treviranus in his work, *Biologie oder Philosophie der lebenden Nature*, published in 1802, emphasized the indefiniteness of variation, but assumed that some of it was adaptive response to the environment and some due to sexual crossing. Johann Wolfgang Von Goethe (1749-1832), the German "poet of evolution", also believed in the direct influence of environment in producing specific modifications of structure. None of these thinkers, however, worked out the details of any definite theory.

A remarkable pre-Darwinian English publication on the subject of organic evolution which made some stir in its day was the *Vestiges of the Natural History of Creation*, published in 1844 by an English writer, Robert Chambers (1802-1871). Though

⁴ Vide an article on *The New Biology* by J. A. Thomson in *Scientific* 919), pp. 217.

not a scientific expert, this joint editor of *Chambers' Journal* traced the action of general laws throughout the universe as a system of growth and development, and maintained that "the various species of animals and plants had been produced in orderly succession from each other by the action of unknown laws and the influence of external conditions". Although according to Alfred Russel Wallace, the *Vestiges* clearly formulated the conception of evolution through natural laws, Chambers' work was at the time vehemently denounced by Huxley and others—the very men who were to become staunch advocates of the evolution theory after it was formulated by Darwin only a decade and a half later. Such is the strange irony of fate in literary and scientific as in other fields !

In England, the idea of progressive change in animal types was already silently gaining ground. John Hunter (1728-1793) suggested that structure depended on function, or, in other words, that alteration in the structure of an individual organism resulted from an alteration of function which, in its turn, generally resulted from a change of environment and habit.

It is interesting to note that Erasmus Darwin (1731-1802) anticipated more than one idea of his illustrious grandson Charles Darwin or rather of Lamarck. In his work called *Zoognomica* (1794-1796) he noted the general uniformity of plan in all animals by artificial selection and climatic variations, and concluded that "one and the same kind of living filaments is and has been the cause of all organic life".

Second Phase : Darwin and Darwinians.

Most of those whom Lamarck and other Pre-Darwinian Evolutionists failed to convince of the occurrence of evolution, were converted to the theory when, in 1859, Charles Darwin published his epoch-making book entitled *The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. In this book and in his two volumes on the *Variation of Animals and Plants under Domestication* (1868) he demonstrated with an overwhelming wealth of illustrations drawn from years of observation and experiment on plants and animals under domestication, that these adaptations to environment were not always purposive, but that slight fortuitous variations or congenital differences in structure or character which

gave even a slight advantage to any individual in the struggle for life and for mates, tend to be inherited and perpetuated, and in this way favourable chance variations aided and accentuated by natural selection, have produced in course of ages from a few prototypes all the existing species of living beings, moulding each species to suit its environment, and leaving it comparatively fixed in type when the need for variation ceased.

According to Darwin's theory of Natural Selection, or the discriminate sifting that goes on in Nature in the course of the struggle of living organisms against limitations and difficulties, the giraffe's neck has become long because through generations the longer-necked specimens have been able to reach more leaves than their shorter-necked fellows and consequently have been able to survive times of scarcity, while the latter starved and perished. Nature having thus continually selected and preserved the longer-necked specimens, the race has become long-necked. Conversely, the wings of the ostrich became useless when the bird took to running. Hence those individuals which wasted least food and energy in wing-building had the more for leg-building. This gave them the advantage over their stronger-winged fellows and they tended to be preserved. To the Lamarckian factors of "use and disuse" and direct action of the environment, Darwin added those of "natural selection" and "chance variation" due to causes yet unknown. It is now recognized that Natural Selection "is anything but automatic, since living creatures often select their environments, instead of being selected by them, and are active agents in their own evolution". As Professor J. A. Thomson⁵ observes, "There has been an evolution of the sieves as of the sifted. Selection is in terms of previously established systems of inter-relations, ever becoming more complex and thus tending to diminish fortuitousness and to ensure progress".

The publication in 1798 by Malthus (1766-1834) of his *Essay on the Principle of Population* had excited much surprise and attention in and outside England. The main theme of the essay was the tendency of population to increase faster than the means of subsistence. Darwin was impressed by the severity of the struggle for life and for mates among animals and plants in a state of nature, and concluded that this struggle for existence was the inevitable result of the operation, in the animal and vegetable worlds, of the same principle to which Malthus in his *Essay on Population* gave the name "struggle for existence". Darwin adopted this phrase which Malthus had employed in relation to social competition. The preservation,

⁵Vide *Scientia* (1919), page 218.

during the battle for life, of varieties which possess any advantage in structure, constitution or instinct, was by Darwin termed "Natural Selection" and by Herbert Spencer the "Survival of the Fittest". By the operation of natural selection, the less well-equipped forms of life would have a heavier death-rate and a lower birth-rate and thus tend to extinction.

As Huxley says :—"The suggestion that new species may result from the selective action of external conditions upon the variations from their specific type which individuals present—and which we call 'spontaneous' because we are ignorant of their causation,—was as wholly unknown to the historian of scientific ideas as it was to biological specialists before 1858. But that suggestion is the central idea of the *Origin of Species* and contains the quintessence of Darwinism."

Darwin's theory of heredity was based on the doctrine of **Pangenesis**. *pangeneses* according to which every unit or cell of the body is supposed to be constantly giving off gemmules or undeveloped atoms (*pangenes* or buds) which pass by means of the blood to the reproductive organs of both sexes and are transmitted to their offspring and multiplied by self-division. Each egg-cell, as each sperm, contains an entire set of these gemmules representing all parts of the body. In evolution, these parts are simply unfolded and the child therefore comes to resemble its parents. Darwin recognized two classes of hereditary variations, namely, large "single variations" or "sports" as he sometimes calls them, which are rare, and slight "individual variations" which occur everywhere even among the offspring of the same parents. The former are now generally termed "mutations" or "discontinuous variations" and the latter "fluctuations" or "continuous variations". Both of these classes of variations Darwin called "spontaneous" or "indefinite" variations as distinguished from what he called "definite variations"—the direct result of environmental and functional peculiarities. Darwin believed that these "definite variations" or "modifications", as we now call them, were occasionally inherited, and believed that it was by the accumulation of the slight "individual variations" or "fluctuations" that new species arise, whereas the large single variations had little value in evolution. He recognized that variations, although excited by the environment, were determined by internal causes,—and pointed out that the occurrence of parallel variation among different varieties in a species, or species in a genus, clearly indicated that the range and direction of variation were determined by the nature of the organism. Subsequent researches show that Darwin was mistaken in brushing aside the large discontinuous variations from among

the factors of inheritance; whereas the degree of heritability of the minute fluctuations were probably exaggerated by him. Since Darwin's day it has been found that in certain cases selective processes appear to have no efficacy at all, and that as regards certain characters a limit may be reached "beyond which no amount of selection affects anything within the period of experimentation". The new school of biologists are, however, of opinion that "further study of Nature's sifting will bring us back to see that Darwin was right in laying emphasis on the subtlety of natural selection", and that "even slight new departures may be of critical moment and determine sooner or later the survival of the variants possessing them".⁶ Darwin's theory of the "Correlation of Variations" or the favouring of one particular variation involving corresponding variation in correlated structures is receiving ample corroboration from subsequent researches. Darwin showed that species were not fixed categories but halting-places, and that the discoveries of new linking forms often degraded species to varieties.

The marvellous history of the horse is a case in point. Successive geological deposits have revealed a series of extinct forms which almost fill up the gaps which separate the present forms from their oldest representatives. Thus, we find in the lower Eocene Age, the diminutive *Eohippus*, of about the size of a fox; in the next higher division of Eocene, the *Orohippus* showing greater, though still distant resemblance to the equine type; in the upper Oligocene and Lower Miocene, the *Mesohippus* of about the size of a sheep; in the Upper Miocene, the little higher *Miohippus* in the Lower Pliocene, the *Protohippus* of about the size of an ass; until we meet in the Pliocene the *Pliohippus* which represents the last stage of the series before we meet with the true *equus* or horse in the Upper Pliocene.⁷

Thomas Henry Huxley (1825-1895) who in 1854, mercilessly denounced Chambers' *Vestiges*, himself brought out in 1863, his well-known essay entitled *Evidences as to Man's Place in Nature* in which he extended the Darwinian principle of evolution to man. By way of justification for publishing this essay, Huxley writes:—"Inasmuch as development and vertebrate anatomy were not among Darwin's many specialities, it appeared to me that I should not be intruding on the ground he had made his own, if I discussed this part of the general question. In fact, I thought that I might probably serve the cause of evolution by doing so". And he concludes

⁶ Professor J. Arthur Thomson in *Scientia* (1919), p. 218.

⁷ *Nature*, Vol. XVI, p. 471.

with the observation, "Our reverence for the nobility of manhood will not be lessened by the knowledge that Man is, in substance and in structure, one with the brutes; for he alone possesses the marvellous endowment of intelligible and rational speech, whereby in the secular period of his existence, he has slowly accumulated and organized the experience which is almost wholly lost with the cessation of every individual life in other animals; so that now he stands raised upon it as on a mountain top, far above the level of his humble fellows, and transfigured from his grosser nature by reflecting here and there a ray from the infinite source of truth".

It is worthy of note that Huxley had turned a deaf ear to Herbert Spencer (1820-1903) when in his first interview with him, in 1852, Spencer sought to convert him to evolution in its widest sense. As early as 1850, Spencer, the philosopher of the great scientific movement of the second half of the nineteenth century, wrote in one of his letters⁸ that the belief in organic evolution had taken deep root in his mind. "The special creation belief," he wrote, "had dropped out of my mind many years before, and I could not remain in a suspended state: acceptance of the only possible alternative was imperative". In his work *The Development Hypothesis*, published in 1852, he writes strongly against the theory of the special creation of the myriad forms of life, and in the work entitled *Progress, its Law and Cause*, published in 1857, he adopts Von Baer's law that the development of the individual proceeds from the homogeneous to the heterogeneous, and the Lamarckian theory of the hereditary transmission of the modifications of organisms by the exercise of function. While recognizing the importance of the principle of natural selection, Spencer was of opinion that sufficient weight had not been given to the effects of use and disuse as a factor in evolution or to the direct action of the environment in modifying organic structures. Among instances of the operation of the factor of "use and disuse", he referred to the decrease in the size of the jaws in civilized races of man and the inheritance of nervous diseases produced by overwork. The supposed transmission of acquired modifications such as the effects of use and disuse, or of the direct influence of the environment is, however, no longer accepted as a fact by biologists. Spencer's significance in the history of European thought lies in his suggestive generalization of the law of organic evolution as the law of all evolution. He broadly distinguishes evolution into three kinds as inorganic evolution, organic evolution and superorganic evolution. Accordingly, in his *Principles of Psychology* he advocates the generic explanation of the phenomena of the adult human mind by reference to its infant and animal ancestry.

⁸ Duncan, *Life and Letters of Herbert Spencer*, 1898, Vol. II, p. 317.

In 1863, as I said, Huxley brought out his well-known work *Man's Place in Nature*, in which the principle of evolution was extended to Man. Eight years later, in 1871, Darwin himself published his famous *Descent of Man*, in which the main conclusion that he arrived at was that Man is descended from some lowly organized form through the combined action of natural selection, sexual selection, inherited effects of long-continued use and disuse, the principle of correlated growth, direct and definite action of environment such as food, heat, and moisture, "aided perhaps by other means as yet undiscovered". "Sexual selection", says Darwin, "depends on the success of certain individuals over others of the same sex, in relation to the propagation of species; whilst natural selection depends on the success of both sexes, at all ages, in relation to the general conditions of life". "The sexual struggle", Darwin says, "is of two kinds: in the one, the struggle is between the individuals of the same sex, generally the males, in order to drive away or kill their rivals, the females remaining passive; whilst in the other, the struggle is likewise between individuals of the same sex, in order to excite or charm those of the opposite sex, generally the females, which no longer remain passive but select the more agreeable partners. The laws of inheritance determine whether characters gained through sexual selection by either sex shall be transmitted to the same sex or both, as well as the age at which they shall be developed. Variability is the necessary basis for the action of selection, and is wholly independent of it. It follows from this, that variations of the same general nature have often been taken advantage of and accumulated through sexual selection in relation to the propagation of the species, as well as through natural selection in relation to the general purposes of life".⁹

Here it may not be out of place to notice, in passing, one immediate effect of the promulgation of the Darwinian theory of Evolution on the study of Anthropology. With the publication of Darwin's *Origin of Species* in 1859, coinciding in time with the recognition of the occurrence of flint implements in the gravels of the Somme maintained by M. Boucher de Perthes since 1847, following close upon the discovery of the remains of the Neanderthal man, in 1857, and followed, in 1860, by Lartet's discovery of the traces of Pleistocene man in the cave of Aurignac, we find the English Ethnological Society—which though inaugurated (at Dr. Thomas

⁹ *The Descent of Man* (2nd Edition, 1885), pp. 614—615.

Hodgkin's rooms in London) on 7th February 1843, had soon languished into inactivity,—once more waking up and commencing the publication of its new series of Transactions since 1861. Wallace, Herbert Spencer, Huxley and Galton all joined this Society. After the infant Society (then at 4 St. Martin's Place, London), had been split, in 1863, into two camps—that of the Anthropologists and that of the Ethnologists, for the latter could not tolerate the word Anthropology, whereas the former would tolerate no other word,—we find in 1868, the Ethnologists making Huxley their President, while the Anthropologists made Beddoe theirs. It was not until the 14th of February, 1871, that the two camps were reunited under the name of the Anthropological Institute of Great Britain and Ireland, with Sir John Lubbock (afterwards, Lord Avebury) as their first President. To commemorate the services of Huxley, the authorities of the Institute founded in 1900, a Huxley Lectureship; and a Huxley Memorial medal is still regularly presented for an annual address before the Institute.

Darwin's great contemporary, Alfred Russel Wallace (1823-1915), shares with him the credit and honour of formulating the explanation of the manner in which organic evolution is effected, namely, the origin of species by the modification of pre-existing species. To Wallace's studies of island life and the work of other observers on local races of animals and plants is due the conception of 'segregation', apart from differences of environment, as being one of the factors in the differentiation of living forms.

The special factor which distinguishes Wallace's scheme from that of Darwin as well as of most later thinkers is the hypothesis of a spiritual world behind the world of matter, the latter being considered as subordinate to the former. "To this spiritual world," says Wallace,¹⁰ "we may refer the marvellously complex forces which we know as gravitation, cohesion, chemical force, radiant force, and electricity, without which the material universe could not exist for a moment in its present form, and perhaps not at all, since without these forces, and perhaps others which may be termed atomic, it is doubtful whether matter itself could have any existence. And still more surely can we refer to it those progressive manifestations of life in the vegetable, the animal, and man—which we may classify as unconscious, conscious, and intellectual life, and which probably depend upon different degrees of spiritual influx."

¹⁰ *Darwinism*, A. R. Wallace, (Macmillan & Co., 1912), page 474.

The Darwinian doctrine of Organic Evolution through variation aided by natural selection has since been considerably modified and supplemented by the researches of subsequent naturalists, particularly of Weismann, Mendel, Lloyd Morgan and De Vries. In fact, Darwin himself took care to note that the expression "chance variation" used by himself merely expressed ignorance of the causes of variation. And post-Darwinian evolutionists have been mainly concerned with researches into the probable causes of different kinds of variations, their relative values, permanence and heritability, and the discrimination between those which may and those which may not be the material for the differentiation of species.

Besides Wallace, Huxley and Spencer, there were among the followers of Darwinism in England such eminent scientists as the geologist Sir Charles Lyell, the zoologist and ethnologist Sir John Lubbock (Lord Avebury) and the botanists J. D. Hooker and Asa Gray. The last survivor of the Darwinian period, who only passed away last year, was the German biologist Haeckel (1834-1919) who carried the Darwinian principle to such extreme lengths of materialism that Darwin, in 1868, wrote to him, "Your boldness sometimes makes me tremble". Haeckel practically recognized no essential line of cleavage between organic and inorganic nature. In the tetrahedral carbon atom, as developed in the complex albumenoid compounds, he saw the only cause of the specific phenomenon of movement which characterizes organic substances. Through *abiogenesis*, or spontaneous generation, says Haeckel, the first living protoplasm arose from such nitro-carbons by a chemical reaction, and during ages of unknown duration, these unicellular beings ("moners") without structure and without any nuclear differentiation have been evolved into higher plants and animals including man. In his supposed "biogenetic law of development" he finds a guide to retrace the phylogenetic succession of species. The human mind, according to him, has been evolved by the same processes which gave the human body its present form.

The first great name after Darwin and Wallace is however that of August Weismann (born 1837). This distinguished German biologist propounded what is known as the "germ-plasm"¹¹ or "chromosome" theory as distinguished from the corpuscular or pangenesis theory by which Darwin tentatively sought to explain the mechanism of the inheritance of acquired characters. Every living organism is composed of cells or

¹¹ His book on *Germ-plasm* was published in 1865.

unit-corpuscles, each with a nucleus containing a number of minute loops called chromosomes. Weismann maintained that some variations are congenital while such variations or modifications as are acquired through the action either of the environment or of use and disuse are not transmitted, as such, but that what is transmitted is only the capacity to become similarly modified under similar stimuli,—that heredity is the transmission of factors of inheritance not the actual reappearance of characters in successive generations. Weismann was among the first to recognize the intrinsic connexion between the evolution of the species and Cytology or the science of cells. He began by applying himself to the problem,—“how it was that in the case of all higher animals and plants a single cell was able to separate itself from amongst the millions of the most various kinds of which an organism was composed, and by division and complicated differentiation to reconstruct a new individual with marvellous likeness unchanged in many cases even throughout whole geological periods”.

A study of the structure of cells and of the processes of cell-division shows that when the two germ-cells, the sperm and the ovum, unite in fertilization, we have the fertilized egg-cell in which the full number of chromosomes representing the species is made up of elements of which half are contributed by the male and the other half by the female. And at this stage, the factors of inheritance carried in the germ-plasm on the two sides of the ancestry are mingled, and cell-division proceeds rapidly.

Weismann found that of the cells into which the fertilized egg-cell or ovum of an animal resolves itself, a few, which he called the germ-cells, remain undifferentiated like the original egg-cell itself, whereas the rest are differentiated to form the various parts and tissues of the body. The germ-cells, he believed, are destined for reproduction, and collectively form the *germ-plasm*; whereas the body-cells or cells which collectively make up the body he called *soma*. Weismann identified the *germ-plasm* with the nuclear material called chromatin which is believed to be a living material much more complex than proto-plasm. The mass of germ-plasm which forms the starting point of the new individual consists of a number of “*idants*” each of which are composed of a number of “*ids*” which Weismann identifies with the microsmata contained in the chromosomes. These “*ids*” in their turn, are each composed of a number of minor vital units called “*determinants*” which again are constituted of a number of hypothetical units called “*biophores*”. Weismann maintained that the germ-cells, since they are not descended from the body-cells but only from the fertilized egg-cell, cannot transmit body modifications or acquired characters. The germ-cells serve no other function in the human economy except that of furnishing the means for the continuity

of the race ; similarly the somatic or body cells take no part in producing the germ-cells of the next generation, although they themselves are produced from the pre-existing germ-cells. In this way one generation is directly continuous with those that precede and those that follow ; and the phenomena of heredity are possible. This idea of the continuity of the germ-plasm is the greatest contribution of Weismann to modern embryological research. The non-transmissibility of acquired characters, is, as we have seen, one of the logical consequences of this idea of the continuity of the germ-plasm, for the molecular structure of the germ-plasm is already determined inside the embryo. Weismann supposed that his "determinants" which correspond to the "gemmules" of Darwin, originate solely in the germ-plasm and thence migrate into the various parts of the developing body thus differentiating the parts. Weismann's "determinants" never pass from soma to germ-cells but always from the germ-cells to the soma. Thus the Lamarckian and Darwinian conception that all variations originate in the body and are then transferred to the germ-cells is reversed by Weismann, according to whose Neo-Darwinian theory, all variations originate in the germ-plasm. As each new germ-plasm grows out of the union of the germ-plasms of the two parents, there arises a mingling of their characters in their offspring. And thus every individual is a complex result reproducing in ever-varying degrees the diverse characteristics of his two parents, four grand-parents, eight great-grand-parents, and other more remote ancestors ; and that ever-present individual variation arises which furnishes the materials for natural selection to act upon. Weismann would seem to have emphasized heredity almost to the neglect of environment as a factor in organic evolution. He merely recognizes an indirect influence of the environment upon the germ-cells. But the new school of biologists of our times, seeking a *via media* between Weismann's theory which belittles the influence of environment and Lamarck's extreme view of environment as the controlling factor in heredity, is probably nearer the truth.

Here, again, it is interesting to note that in India long before Charaka and Suśruta, Aitreya had formulated something like the germ-plasm theory : Aitreya's theory, as reported by Charaka in his work, the *Sārīrāsthāna*, has been explained by Dr. Seal in his monograph already referred to. As Dr. Seal points out, the continued identity of the *germ-plasm* (*bīja*) from generation to generation follows as a corollary from Aitreya's doctrine of a distinct reproductive tissue. Aitreya's hypothesis has one novel feature which may well deserve the attention of future workers in the field : while Weismann merely

The Germ-plasm theory in Ancient India.

suggested that the oscillations and changes in the blood and other nutritive fluids may stimulate the germ-plasm to a new departure, Aitreya definitely postulates the interaction of the germ-plasm and the somatic tissues.¹²

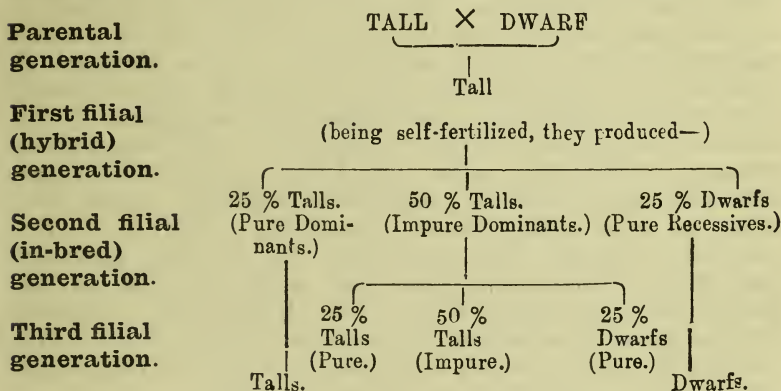
Third Phase : Post-Darwinians.

The first great name in the Post-Darwinian history of the evolution theory is that of the Austro-Silesian abbot, Gregor Johann Mendel (1822-1882), with whom we enter the third phase in the history of the theory of biological evolution. His celebrated memoir *Versuche uber Pflanz-hybriden* (Experiments upon the hybridization of plants) published in the *Proceedings of the Natural History Society of Brünn* as early as 1865, attracted little attention until 1900, when H. De Vries recognized its value. After protracted experiments for eight years on crossing different varieties of garden peas, Mendel made the important discovery that there are characters which *blend* and others which *segregate*, when crossed. Unlike his predecessors, Mendel studied the behaviour of each individual character instead of considering the organism as a whole ; and he studied it in several successive generations of the plant, and was thus able to inaugurate a great advance in the study of Heredity. Mendel's breeding experiments on more than 10,000 plants showed that by fertilization, the characters of the parents, though united, do not lose their purity and independence so that in the offspring, the characters of both parents may again be separated from each other, and the character of one of the parents may completely suppress that of the other and thus become "dominant" while that of the other parent becomes "recessive". Dominance thus means the complete resemblance of the first hybrid generation to one of the parents. Mendel's experiments showed that in the first generation all the offspring exhibit the character of one of the parents (dominant), that of the other parent (recessive) not appearing at all, and that in the second generation, out of the offspring of these hybrids of any two different characters, one half again develop the

¹² Aitreya's theory of the inter-action of the germ-plasm and the soma would appear to afford a better explanation of some phenomena which cannot be adequately explained on Weismann's doctrine. Even among Western biologists, the unqualified doctrine of non-heritability of acquired characters is not universally accepted. And trenchant criticisms of Weismann's theory have been made by such distinguished writers as Eugenio Rignano, the Editor of *Scientia*, and a few others. Rignano in his work *Upon the Inheritance of Acquired Characters* (Chicago, 1911) has elaborated a theory of development which he terms "Centro-epigenesis", in which the essential idea is that there is a central zone of development which exerts an infinite variety of powerful influences on the rest of the organism "by activating successfully a regular series of specific energies, each remaining in a potential state up to the time of its activation". The author seeks to support his theory by a variety of experimental evidence. On the basis of this central doctrine Rignano seeks to explain the inheritance of acquired characters.

hybrid forms, while the other half yield offspring which remain constant and possess the dominant and recessive characters in equal proportion. Thus, by crossing tall and dwarf forms (of which the tall form is dominant) we obtain a hybrid "tall" progeny which, in their turn, produce 75 per cent. tall and 25 per cent. pure dwarf progeny. Of the 75 per cent. tall, 25 are pure, like the one original parent, and the remaining 50 are impure, like the first cross or hybrid parents. Thus, in the second hybrid generation, we have 25 per cent. "pure tall" like the one original parent, 25 per cent. "pure dwarf" like the other original parent, and 50 per cent. hybrid like the first cross. The pure dwarf individuals of the second generation are found to breed true, and the fraction of the population that are hybrid is halved in each successive generation.

The results of Mendel's experiments have been represented as follows:—



This regular distribution of the parental characters amongst the individuals of succeeding generations is explained by the theory of the purity of the reproductive cells, each of which is taken to contain a portion of the germ-plasm with a perfectly definite structure, so that the reproductive cells of the hybrid do not all receive an "average sample" of the germ-plasm, but half of them come to possess the factor for tallness, while the other half go without it. The factor is not divisible but must be either present or absent, and is, in fact, present in one half and absent in the other half of the reproductive cells. A particular reproductive cell may carry the factor for tallness or shortness but the hybrid condition cannot be represented in a single reproductive cell. Each male or female reproductive cell is believed to contain a complete set of factors for determining the characters of an individual, so that the fertilized ovum and, therefore, the organism which develops from it, is a double structure in which each character is represented in duplicate, one set having been obtained from the male parent, and

the other from the female. The factors may be in similar or dissimilar pairs according as the male or female reproductive cells which formed it were the same or different.

Mendel, like Weismann, conceives of the hereditary relation as one between the parental and filial germ-cells, and not as one between the bodies of parent and offspring, and regards the organism as composed of a number of definite, separable heritable characters.

Thus, in an organism the number of characters are capable of varying independently and of being isolated; and each set of these characters Mendel calls "unit characters" and the factors governing them "unit factors" (such as, colour). These "unit factors" are not distinct corpuscles of living matter representing separate cells but definite chemical substances forming part of the chain of metabolizing compounds. The total inheritance transmitted in a gamete or germ-cell may be taken as composed of definite independent "unit factors" contributing to the development of corresponding characters. Any alteration in the psycho-chemical structure of a factor either by the shifting or re-arrangement of the chemical atoms, gives rise to a "mutation". A "retrogressive mutation" results when such a unit factor is lost or fails to pass into the gamete, and a "progressive mutation" when new atoms or compounds become permanently involved in the metabolic cycle of the germ-plasm. It is now generally conceded by Mutationists that the change occurs in the production of the sexual cells before fecundation. Germinal changes also occur in response to subtle environmental and nutritive stimuli which penetrate into the germ-plasm in the process of the ripening and fertilization of the germ-cells.

Mendelian experiments, as I have explained, show that when two varieties are crossed, the dominant and recessive forms vary in the ratio of three to one in the second generation. All the recessive forms breed true in future, but of the dominant forms one-third only breed true, and two-thirds reproduce in the third generation the mixed result of the second. Thus, cross-breeding does not lead to the indefinite mixture of characters. And gaps in nature become possible through such segregation. Segregation or separating out in definite proportions, in the second generation, of the dominant and recessive characters combined in the cross, in two different sets of gametes or germ-cells is, in fact, the essence of the Mendelian doctrine. Results of recent experiments have, however, broken down the Mendelian conception of the sharp contrast between "dominant" and "recessive" characters and the proposition that the members of an allelomorphic pair are completely segregated in the

gametes. The criterion of blending and of alternating in the Mendelian manner is yet unascertained. Such characters as colour in human races have so far defied analysis into segregating factors. Dr. Charles E. Walker, however, in his work on *Hereditary Characters*, maintains that *racial* characters tend to *blend*, and individual characters are transmitted in an *alternative* or Mendelian manner. It may be noted, however, that although there is a general blending of characters in the case of such cross-breeds as the mulattoes descended from Europeans and negroes, the mestizos from Europeans and Red Americans, and the zambos from Red Americans and negroes, there is a more or less tendency to revert to one or other of the original types which appears to distinguish them from fully established races or sub-races.

From experiments mainly on maize, C. H. Shull and East have made the subsidiary discovery that the vigour of a plant is influenced not only by the characters which it possesses but also according to whether these characters are present in the pure or hybrid condition, the latter being connected with extra vigour. Professor Johannsen in his paper *On Inheritance in Mixed Population and in Pure Lines*, published in 1903, effected an important change in our notions of Heredity. His experiments on what he calls 'pure lines' or the descendants of a single individual of a race which is reproduced exclusively by self-fertilisation, showed that instead of a tendency in the individual characteristics of the parent to be reproduced in the offspring, there was a tendency to reproduce within normal limits of variation the average character of the pure line to which offspring and parents alike belonged.

The doctrine of *Pure line Inheritance* modified the older idea that variation and change was the universal rule, for real variations of hereditary value are found to be rare within the pure line. Such variations as occur are of the nature of acquired characters and therefore probably not inherited; where, as in rare instances, heritable changes are found, they would seem to be *mutations* or *saltatory changes*. Thus the constitution of the germ-plasm of a pure race would appear to be perfectly definite and constant and not variable around a mean. The fact of "pure line" inheritance would thus appear to be in accord with the Mendelian doctrine.

The theory of the segregation of the dominant and the recessive characters in two different sets of gametes or germ-cells, as I have said, forms the corner-stone of Mendelism. As Bateson, the leader of the present Mendelian school in England, says, "The essential part of the discovery is the evidence that

the germ-cells or gametes produced by cross-bred organisms may in respect of given characters be of the pure parental types, and consequently incapable of transmitting the opposite character ; that when such pure similar gametes are united in fertilization the individuals so formed and their posterity are free from all taint of the cross ; that there may be, in short, perfect or almost perfect discontinuity between these germs in respect of one of each pair of opposite characters. Mendel's theory, as Bateson points out, has overthrown the Darwinian conception of evolution as proceeding through the gradual transformation of masses of individuals by the accumulation of impalpable changes". "For the facts of heredity and variation unite to prove that genetic variation is a phenomenon of individuals. Each new character is formed in some germ-cell of some particular individual, at some point of time". "The discontinuous variation," Bateson suggests, "are in the main the outward manifestations of the presence or absence of corresponding Mendelian factors, and the unity of these factors is a consequence of the mode in which they are treated by the cell-divisions of gameto-genesis". Variations due to the addition of one or more elementary factors is characterized by Bateson as the consequence of a process of unpacking ; and 'reversion' which "occurs when the sum-total of the factors returns to that which it has been in some original type", may be called re-packing. It is in the cutting and shuffling of the pack of hereditary unit-characters that diversities originate.

Research has not yet proceeded far enough to show whether Mendel's law applies to all characters and in all kinds of living organisms, though it has been found to apply to many species of plants and animals. Although in many organisms a large number of unit characters do not appear to blend but behave in inheritance as if they were indivisible entities, being present in their entirety in a certain proportion of the descendants and altogether absent from the rest, there are other organisms in which the divergent characters of the two parents appear to blend in the offspring, thus producing an intergrade. Mendelian segregation and inheritance has been found to apply, among others, to such characters as form and colour of leaves in certain plants, colour in a number of species of flowers and animals, the presence or absence of horns in cattle, length of hair in certain animals, certain feather characters in birds, resistance to "rust"-disease in wheat, and certain abnormal conditions in man, such as the brachydactylous or short-fingered condition and the Hapsburg lip. Although the same laws would appear to govern inheritance in man as in other animals and in plants, most of the physical and mental characters of man cannot unfortunately be subjected to experiment ; and all that we can do is to observe and compare the inherited characters

in successive generations and seek to ascertain with what recognized law or laws of heredity, blending inheritance or Mendelian inheritance, pure or sex-linked, they best agree. A considerable amount of data with regard to the colour of skin, hair and eye, form of the hair, general mental capacity, longevity, insanity, night blindness, hereditary epilepsy, and so forth, has already been collected by Karl Pearson and his followers in England and Dr. C. B. Davenport and his associates, Plate and others, in the Eugenics Record Office in New York. We shall refer to some of their results in a subsequent lecture. Professor Castle of Harvard maintains that, apart from colour, there are very few valued economic characters in domestic animals which are not inherited after the manner of blends.¹³

Sir Francis Galton (1822-1911) was the first to recognize, as early as 1889, the distinction between alternative and blending inheritance, but he sought to unify the two categories of cases, and, in 1897, formulated a generalized "law of ancestral heredity" according to which each more remote generation has only half the influence of the succeeding one. To use Galton's own words:—"The two parents contribute between them on the average one-half, or (0.5) , the four grandparents one quarter (or $(0.5)^2$), the eight great-grandparents one-eighth or $(0.5)^3$, and so on. Thus the sum of the ancestral contributions is expressed by the series $[(0.5) + (0.5)^2 + (0.5)^3, \text{etc.}]$ which being equal to 1, accounts for the whole heritage". Although this law applies fairly well to blending characters, it fails completely when alternative or Mendelian characters are concerned. And thus Galton's attempt to include in the same classification of "ancestral heredity" two things of unlike character—namely, blending and Mendelian inheritance—is now generally discredited.

But Galton's will be an honoured name as the founder of the study of Eugenics designed to improve the inherent qualities of the human race by applying the Darwinian theory of evolution to human society. Galton's studies of family histories had convinced him that physical and mental traits are largely matters of inheritance. Galton further proved by experiments with vegetables and by observations on mankind that when any part or organ has been increased or diminished by selection, the offspring shows a

¹³ Dr. Eugen Fischer's observations (1912) on the offspring of Dutch Boers and Hottentots in German South-West Africa go to show the complete and marked fertility of the hybrids *inter se* and the increased bulk of offspring of such mixed parentage, even when there has been no appreciable change in the environment; and many characters generally considered as distinctive of "race" have been found to "mendelize" out in the hybrid offspring, thus shaking the theory of the origin of races or sub-races through miscegenation.

strong tendency to revert to a mean or average size which is not a mean of the actual existing individuals but a lower mean than that from which they had been recently raised by selection. Galton called this the law of "Retrogression towards Mediocrity". This regression is said to occur in every generation even when both parents have been selected for their high development of the particular organ. It is considerably hastened when what Weismann calls "panmixia" or free intercrossing is allowed among individuals of varying grades of development, so that after a time the mean will be greatly reduced and the organ in question will rapidly decrease till it falls considerably below the mean of the progeny that has usually been produced each year. His experiments further show that there is often a proportion between the frequency of a particular variation and the amount of its deviation of the character in question, so that when the frequency and the magnitude of the variations are recorded, they often show what is called the Normal Curve of Frequency. Thus, among measurements of 2,600 men taken at random, there was found 1 of 4 feet 8 inches and 1 of 6 feet 8 inches; 12 of 5 feet, and about 12 of 6 feet 4 inches,— i.e., equal numbers at equal distances from the mean of 5 feet 8 inches. Galton is further remembered as the founder of Biometry or the statistical study of variation and heredity, although its full development is mainly due to the valuable work of Karl Pearson. In order to collect and analyze data concerning human inheritance, Galton founded the Eugenics Laboratory of the University of London, to which I have already referred. It is to be hoped that some of the enlightened millionaires in this Province may before long found and endow similar institutions for the advancement of science and the benefit of humanity. Incidentally it may be noted that Galton was from the beginning an active member of the old Ethnological Society of London and was appointed its secretary in 1862-63. After the society became the Anthropological Institute, we find him acting as its President from 1885 to 1888. In 1888, we find him giving the Institute the entire proceeds of his lectures at the Natural History Museum, South Kensington, in order to give partial relief to the Institute in its financial difficulties.

To return to the Evolution theory. In 1870, Ewald

**Hering's
Theory of
Organic
Memory.**

Hering in a paper read before the Imperial Academy of Science at Vienna, "On Memory as the Universal Function of Organized Matter" formulated the biological doctrine of *unconscious or organic memory*. He regarded memory, in the wide biological sense of retention of the effects of stimulation, as a fundamental attribute of living matter. According to him the existence of life with growth and develop-

ment implies the existence of organic memory since each new organic process is the outcome of the old and implies its retention. As a corollary of this doctrine, Hering formulated the doctrine of the heredity of acquired characters in the following words:—"We have ample evidence of the fact that the characteristics of an organism may descend to the offspring which the organism did not inherit but which it acquired owing to the special circumstances under which it lived. What is descent of special peculiarities but a reproduction on the part of organized matter of processes in which it once took part as a germ in the germ-containing organs of its parent, and of which it seems still to retain a recollection that reappears when time and occasion serve?"¹⁴

In 1886, three naturalists, Lloyd Morgan, F. Osborne and Mark Baldwin, each independently formulated the theory of *organic selection*, by which, as Baldwin himself says, "the Darwinian theory of evolution by natural selection is very materially recast." The evolution theory is no longer one resting exclusively upon fortuitous congenital variations. For, as Baldwin says, "In many important instances it is not upon such variations, taken simply for themselves, that the preserving hand of selection falls, but upon those only which show their fitness to serve the ends of conscious adaptation and of mind. Selection falls upon the variations only because it falls first upon the entire living function in which the variations are included and protected. The function which survives, and with it the anatomical characters, are those which present the successful union and joint operation of endowment (present in the variation) and experience (present in the accommodation)." ¹⁵

Thus, Darwin's theory of the origin of species by infinite small variations gradually accumulating through numerous generations naturally selected on account of their usefulness in the struggle for life and mates was, as we have seen, modified by Mendel's discovery that new species may be formed quite rapidly by an artificial interference with the coupling of the germs. Mendel's experiments on plants, as we have seen, proved that such couplings might give rise to organisms with characters so distinct as to constitute a new species. As early as 1889, Francis Galton in his work on *Natural Inheritance* had classified variations

¹⁴ Translated from the original German paper by Samuel Butler and incorporated in his book *Unconscious Memory*.

¹⁵ Article on "Organic Selection" in Dr. Hastings *Encyclopædia of Religion and Ethics*.

into *continuous* or graded variations and *discontinuous* variations separated by gaps with no intermediate stages to connect them, and suggested that discontinuous variations may be *species-forming* variations, stable from the start, whereas slight or graded variations may have no lasting effect, like the oscillations of the polyhedron on one and the same face. And Bateson, the principal founder of "Mendelism" or the science of Genetics, in a book entitled *Materials for the Study of Variations*, published in 1894, suggested that discontinuous variations are more important in species-formation than are continuous ones, because, in discontinuous variations, selection determines the survival of one or the other of two distinct groups, since intermediates do not occur and it is unnecessary to assign selection value to each plus and minus gradation of an organ.

Finally, in the year 1900, the distinguished Dutch botanist
"Sports" or Hugo DeVries of Amsterdam definitely
Mutation extended the Mendelian doctrine with the
Theory. theory that new species were largely sudden
 formations. Mutation involves a change in
 the nature of the germ-cells, whereas fluctuation involves only the
 soma and but temporarily the germ-plasm. DeVries does not
 indeed deny that selection acting upon "fluctuations" or contin-
 uous variations may change the average condition of the race,
 but he thinks that such changes will not persist unless main-
 tained by rigorous selection so that as soon as selection ceases,
 the race begins a gradual return to its former condition. Thus,
 according to this theory of "sports" or "mutationism" which
 DeVries himself called the "law of splitting of hybrids",
 and which was really discovered by Mendel and rediscovered by
 DeVries, species arise from one another by discontinuous leaps
 and bounds and not by continuous minute individual variations or
 "fluctuations" as maintained by Darwin. In a recent paper on
The Present Position of the Mutation Theory, DeVries says
 that the mutation theory "supposes that production of species
 and varieties proceeds by small distinct steps, each step corre-
 sponding to one or more unit-characters" and that "it is only
 after their appearance that the environment can decide about
 their utility". Again, "It is now generally conceded by muta-
 tionists that the initial change takes place in the production of
 the sexual cells before fecundation. From this conception it
 follows that the chance of two similarly mutated cells to meet
 one another in this process must be very small, whereas ordi-
 narily the mutated cells will combine with normal ones. This
 must produce half-mutants, and these may in ordinary cases
 at least, split off the full mutants after the same rules which
 Mendel discovered for his hybrids. Sometimes the half-mutants

will be distinct from their ancestors, as in *Oenothera Lamarckiana rubrinervis* and *erythrina*, and therefore will easily be discovered. In other instances external differences may be absent, and only the unexpected production of a new type in about 20 to 25 per cent. or more of the individuals will betray the internal change. This explains the mass-mutations discovered by Bartlett. Such an indirect way of producing mutations by means of two successive steps seems to be very common in nature, and will probably afterwards prove to be the general rule".¹⁶

Although, "mutations" have now been observed in a large number of cases, it is perhaps yet premature to determine "whether the bat got its wings gradually on the lines of Lamarck's, Darwin's or Weismann's theory, or more rapidly, by large changes", on the lines of Mendel's, DeVries' or Bateson's doctrines.

Such are the main ideas by which it has been sought to account for the changes in the world of living organisms including man. Whatever be the process by which these modifications of forms are brought about, accumulated, perfected, and inherited—palæontological, zoological, and anatomical researches unmistakeably vouch for the occurrence of these progressive organic changes, inspite of occasional stray instances of retrogression, reversion or atavism,—and appear to indicate that the successive species of animals exhibiting increasingly higher and more complex forms of life are connected by parental descent—man with the mammals of the Tertiary epoch, the mammals with the reptiles of the Secondary epoch, and the reptiles with the fishes of the Primary epoch.

Although subsequent researches may show Darwin's particular account of the mode of these changes to have been partly or even wholly erroneous, still the Darwinian principle of the existence of an orderly change or evolution is now firmly established and it is upon that principle that the science of Anthropology is founded. As Dr. Marett says,—“It is the Darwinian outlook that matters. None of Darwin's particular doctrines will necessarily endure the test of time and trial. Into the melting-pot must they go as often as any man of science deems it fitting. But Darwinism as the touch of nature that makes the whole world kin can hardly pass away. At any rate, Anthropology stands or falls with the working hypothesis derived from Darwinism, of a fundamental kinship and continuity amid change between all the forms of human life”.¹⁷

¹⁶ *Nature*, Vol. CIV, pp. 213-14.

¹⁷ Marett, *Anthropology*, pp. 10-11.

I have now finished my hasty and imperfect survey of the salient facts in the history of the evolution theory. This theory of progressive change, it is now generally agreed, affords the most satisfactory explanation of the present condition of the world in terms of simpler pre-existing conditions. To enable him to understand the physical, intellectual and emotional make-up of man and his races,—man's body and intellect, his immunities and diseases, virtues and vices,—the study of the laws of heredity and environment is clearly a *sine qua non* for the student of anthropology. These laws alone can explain how unit-characters or other factors go to make the difference between one man and another and differentiate mankind into races,—how the body of man is gradually improving and his mind is continually widening with the process of the suns,—and how throughout the organic world “through the ages, one increasing purpose runs”. While heredity is, as we have seen, the main factor in man's biological evolution, and the race may be physically improved only by an improvement of the germ-plasm, social and other environment is a most potent factor in determining and shaping his cultural evolution. And in the light of the knowledge of the laws of heredity and environment, civilized man may, to a large extent, take his biological as well as cultural evolution in his own hands. By selecting and improving his environment, so far as possible, and by acting through heredity,—through the control of matings and the selection of parents for the next generation,—he may, to a great extent, prevent the action of natural selection, and effect infinite improvement in the race.

As the poet says,

Man as yet is being made, and ere the crowing age of ages,
Shall not æon after æon pass and touch him into shape?

LECTURE IV.

The Evolution Theory as applied to Man.

IN my first lecture I endeavoured to explain to you how Anthropology by strictly scientific methods, proceeds to determine man's place in the animal kingdom and comes to the conclusion that he constitutes the highest family in the sub-order Anthro-poidea of the order of Primates.

In the second lecture we saw that the scanty fossil remains of ancient man and the supposed human artifacts dug out of Tertiary deposits as well as the discovery of fossils of different anthropoid apes in the Miocene and Oligocene ages, appear to indicate that the humanoid line branched off from the common anthropoid ancestral stock at about the middle of the Oligocene age, if not earlier; and we further saw that the earliest undoubted osseous remains hitherto discovered of a man-like creature belong to the latest Pliocene or earliest Pleistocene age, so that in the present state of our knowledge, the Pliocene may be provisionally taken as the period of the first appearance of Man, as such, on earth. In this lecture we shall enquire as to How, or the process by which, Man was evolved from a common anthropogenic stock. The evolution of Man as a distinct species from a lower form must presumably have proceeded much along the same lines as those followed by other living organisms. As we have seen in the last

Process of Organic Evolution.

lecture, biological research shows that the constitution of every living organism is the product of the co-operation and interaction of two factors—the internal, germinal or constitutional factor of heredity and the external factor of environment.¹ The plasticity of organisms is considerable. All living organisms appear to vary from one another: no two individuals look exactly alike. Some of these variations (the “mutations” of DeVries) are not the product of environment but are partly

¹ The principal environmental factors which act upon an organism are, firstly, *mechanical*, such as amount of space, pressure, and tension; secondly, *chemical*, such as food, air, and water, which are concerned in the process of metabolism; thirdly, *physical*, such as heat, light, and electricity, and lastly, *vital*, such as the influences exerted by other living organisms—plant life and animal life—around him. Important changes in the environment may not improbably penetrate into the body and indirectly provoke the germ-cells to vary.

an outcrop of the constitution of the germinal material of the varying organism and partly perhaps the effects of the permutations and combinations in accordance with the law of Mendelism. As a consequence of the occurrence of variations in every living organism, some individuals of a species happen to fit the environment better, and these being better fitted to maintain and advance the species, survive their less fortunate fellows and advance the type. Even in a continuous environment, the power of adaptive response to its stimuli is necessary for the maintenance of the normal type of the organism. In a shifting environment such power of adaptive response to external stimuli is still more essential for the organism to change suitably and avoid extinction. All such variations, however produced, have to pass through the sieves of a rigorous natural and organic selection, and the selected products by reason of their new adaptations form new varieties, races or sub-species, and species. Only such characters can be transmitted to the offspring as are contained in the germ-cells, or are, directly or indirectly, transmitted to them.

It was by such a process of variation and selection from one common ancestral stock (sub-order) of Anthropeida that the immediate ancestors of the family *simiida* diverged as a collateral branch along a certain line of evolution which probably proved of immediate benefit to them. The immediate ancestors of the family *Hominida*, on the other hand, through continuous fitter variations and conscious or subconscious organic selection acquired specific differences and adaptive structures that gradually led them on to the summit of all living organisms.

Pre-Man thus began as an organism that was, in body and in brains, superior to the mere animal, though as yet greatly inferior to man as we know him. From this stage he could not have passed at once to perfect "manhood".

General view of Man's Physical Evolution.

A protracted "apprenticeship" must have been undergone, during which hand and brain, intellect and emotions, acted and reacted upon one another and combined in bringing about an all-round uplift. Useful germinal variations served as the fostering nurses of environmental modifications in the same direction. Through natural selection thus guided by organic adjustments in lines coincident with themselves, favourable modifications accumulated from generation to generation, until they acquired independent "selection value". In this way through the combined action of natural and organic selection, and the law of correlated growth, Pre-Man gradually accumulated, through successive generations, such favourable variations, some of them gradual and others sudden or saltatory, as were transmissible and as were called for by his impending advance to the rank of Man, and gradually eliminated from his

organism such brute features as interfered with or did not further the attainment of that goal. Such appears to have been the process by which through successive morphologic modifications, at times more rapid than at others, our first generalized human forbears may be inferred to have gradually evolved from some anthropogenic stock probably in some comfortably warm forest-clad region of the earth.

It is not to be taken, however, that the evolution of man, or of other living organisms, has proceeded along a straight line from one dominant type to another. The theory of orthogenesis, as it has been named, has been discredited by the evidence of palæontology. The road of evolution is strewn with relics of its wastrels and failures. And *Pithecanthropus* may not improbably have been one of them. The inevitable tendency of every group of organisms is to expand and branch off in various directions of adaptation. This specialization gradually destroys its plasticity or variability in other directions, and disqualifies it to adapt itself to new conditions, while some obscure collateral branch acquires some advantageous combination of characters, enabling it to win the race and outstrip the hitherto dominant type which is left to stagnate or perish. In the darkness of the Tertiary epoch, what different branches the first semi-human stock had thrown off only to be finally eliminated as unfit to meet new and changing conditions we have no means at present of knowing. The line that became the common Pliocene ancestral group from which the existing races of mankind have descended, must have developed and survived by a process of extraordinary progressive differentiation.

Although the general lines on which man's evolution has proceeded may be approximately guessed, we can do no more than speculate as to the long series of evolutionary changes, particularly the earlier stages, by which the wide gulf between the brute and the man was crossed. Many experts are of opinion that the arboreal habit of our remote ancestors, necessitating, as it did, the gradual adoption of an orthograde or erect posture helped in developing those special attributes which we would term human. And recently Dr. Wood Jones² has, by an elaborate examination of the comparative anatomy of man and other mammals, attempted to show that very early in mammalian life, before the forelimbs sacrificed their primitive mobility to the needs of stability, the particular mammalian stock which culminated in man developed the arboreal habit, and that man had not, as is commonly held,

² *Arboreal Man* (London, 1918), pp. 12 seq. The conclusions of Dr. Wood Jones with regard to man's physical evolution have, in the main, been adopted in this lecture.

assumed the upright posture from a previous quadrupedal pronograde mammalian stage. He maintains that man is the culmination of a series of ancestors in whom the arboreal habit preserved the primitive mobility of the forelimb and thus laid the path for his evolution as Man. Whether this view will, in its entirety, stand the test of further research or not, it appears probable that as Professor Klaatsch observes, "Man and his ancestors were never quadrupeds as the dog, or the elephant, or the horse", and experts are generally agreed that the erect posture resulting from the arboreal habit gradually produced a long series of adaptative alterations, and advantages in structure and function in the human body, which led to most of the peculiar features of Man.

As for these structural and functional alterations, it is not unreasonable to infer, with Dr. Wood Jones, that they proceeded on lines something like the following.

The repeated use of the hind-limbs in supporting the body in arboreal life would lead to their anatomical modification by making the femur thicker, **The forelimbs and hindlimbs.** the tibia stronger and well developed, and the fibula thinner and narrower, and causing fusion between some of the primitive tarsal bones. Alteration of function would also lead to changes in the muscles of the hind-limbs, the primitive rotators being replaced by flexors such as the popliteal muscle of the knee-joint.

The arboreal habit would naturally develop the power of grasp in the hand; the higher the animal would climb the smaller would be the branches encountered and so the more perfect would be the adjustment of the grasp by flexion of the fingers. **Development of the power of grasp.** This power of grasp would be further utilized to grasp leaves and fruit and other food; it would help the mother to grasp the offspring, and nurse it, and generally to feel and test more objects with the hand. In animals, such as in some monkeys which retain their climbing habit, the lower limbs are both supporting and grasping organs so that all the four limbs are generally alike, and the thumb and the hallux or great toe can both be opposed. In man, the grasp is developed in the hand and thus the hallux loses its opposing power as among most modern living races, although several primitive races such as the Sakai and some other Negrito tribes, as also a few civilized peoples of north-eastern Asia, still retain prehensile big toes. The erect posture would further lead to the development of a heel, the beginning of which is seen in the gorilla. It is interesting to note that the power of toe-grasp is retained in children and the in-turning or inversion of soles in children is a characteristic of arboreal primates.

When children learn to walk, they rest on the outer side of the feet which is also an anthropoid characteristic. Eversion of the feet is developed later. The extraordinary hand-grasp or grip of children is also worthy of note. In some primitive races, the foot-grasp is well developed. Thus, with a firm grasp of the big toe, primitive tribes, like the Sakais and the Semangs of the Malay Peninsula, can climb up trees, monkey-fashion, by putting the flat of their feet, against the trunk, and their arms around it. I have seen Orāons of Chōtā-Nāgpur perform the same feat, and even among some lower classes in Bengal and Bihār this primitive method of tree-climbing is not unknown. Some tribes, walk up the upright stems of gum-trees (Tasmania) or coconut trees (India, Malayasia, etc.), with great facility along what has been called the "monkey ladder" consisting of only a series of slight notches made, as a matter of convenience, for repeated climbing. The Malays rely more upon the foot-grasp than on any of the mechanical contrivances used by some peoples such as the bamboo-pegs used by the Dayaks of Borneo, or the hoop or girdle used by the toddy-palm tapper in Bengal to encircle the tree and his own waist. While climbing the almost vertical stem of coconut trees, the Malay, however, sometimes passes between his two big-toes a thong to supplement his foot-grasp. This contrivance too is not unknown in some parts of India. Arboreal houses such as the *dobo* of Melan asian maidens also form an interesting feature in the domestic economy of some primitive tribes. The pile-houses or houses built on posts several feet high, with the floor above them, such as those of the Nagās, the Garos, the Mishmis, and some other tribes of Assam and the north-eastern frontier of India, as also those of the Dyaks and the Battas of Borneo, the Papuans, and the Islanders of south-east New Guinea need not be supposed to be reminiscences of former arboreal dwellings, as these would rather appear to have been conditioned by the dampness of the soil or devised as a protection against the ravages of the wild beasts that roam in their native jungles. As for the huts or sheds perched on trees in their fields, by many tribes in India and elsewhere, they have still their utility in protecting them from elephants and wild beasts.

To return from this digression. The development of the power of grasp in the hand would lead to a recession of the snout region and jaws, and the development of a chin. Whereas in the lower mammals the habit of reaching their food with the mouth and then eating it, leads to a prolongation of the face region and to the development of the teeth, the power of grasp which enabled our arboreal ancestor to seize his food and carry it to the mouth with the hands would lead to a recession of the

snout region and the decay and gradual reduction in number of the teeth. Thus, from forty-four in the terrestrial *insectivora*, thirty-eight in the arboreal *Tupaia* or tree-shrews, thirty-six in lemurs, the number has dwindled down to thirty-two in the old-world monkeys and the anthropoid apes and in Man. The reduction of the dental series has necessarily led to a shrinkage of the alveolar margin of the jaws, and to the consequent gradual development, in the lower jaw, of a chin which is a distinct characteristic of *homo sapiens*. Man alone has his teeth in a continuous series with no gap between them. It is interesting to note that the basal part of the molar teeth of the higher apes expands into five or six cusps, and that the fifth cusp has been noticed in Tasmanian and Negro teeth though these are absent in civilized races.

The adoption by the "nascent Hominidæ" of mixed in place of frugivorous food-habits and their use of crude flints to cut up and smash their varied food would, it has been recently pointed out by W. K. Gregory,³ greatly contribute to the retraction of the face and dental arch, the reduction of the jaw muscles, and the size of the canines; and, later, when man learnt the use of fire to cook and soften his food, a further modification of the jaws and teeth would follow. As Gregory points out, in spite of the doctrine of the non-heritability of acquired characters, "it is a fact that progressive changes in food-habits and correlated changes in structure occurred in thousands of phyla". He concludes that "whether, as commonly supposed, the food-habits changed before the dentition, or *vice versa*", the evidence appears to show that the Hominidæ passed through the following stages of evolution: first, a chiefly frugivorous stage, with large canines and parallel rows of cheek teeth as in *Sivapithecus*; next, a predatory, omnivorous stage, with reduced canines and convergent tooth rows as in *Homo heidelbergensis*; and finally, a stage in which the food is softened by cooking and the dentition is more or less reduced in size and retrograde in character, as in modernized types of *Homo Sapiens*.

Whereas in the lowest mammals the facial part of the skull preponderates, in man and the anthropoid apes the recession of the snout and the increasing development of the brain leads to the development of the bony case enclosing the brain; and the arteries which supply these parts thus acquire special importance. These general alterations in the configuration of head and face, have led to an alteration of the position of the sense-organs. Thus, the

³ *Bulletin of the American Museum of Natural History*, 1916, Vol. XXXV, Article XIX ("Phylogeny of Recent and Extinct Anthropoids with Special Reference to the Origin of Man"), pp. 252 ff.

eyes have taken up a forehead position, a bar of bone has developed behind them, and intervened between them and the space at the side of the skull in which the jaw muscles lie, and the eyes are lodged in separated bony orbital cavities. The eyebrow ridges which are excessively developed in some of the higher apes, such as the gorilla, form a prominent feature of Neanderthal man as well of some living Australians, but have dwindled into insignificance in modern civilized races whose forehead is almost vertical. It is further interesting to note that the strong bony crest along the median line of the skull in front and above, seen in the gorilla and other apes, has been traced by Sergi in a number of more or less primitive races, especially in the Tasmanians, the Australians, the Fuegians, the Eskimos, some Polynesian tribes, and possibly the Bataks of Palawan. The head-poise has also been altered, the whole skull being now balanced upon its condyles; and a complete change has taken place in the axes of the principal movements of the head upon the trunk, a greatly increased range being thus given to these movements. In man the ability to turn the head quickly in any direction so as to catch a sound proceeding from such direction, has replaced the mobility of the external ear seen in animals that "prick" their ears when they hear sounds.

The erect foot-balance combined with powerful hand grasp would further lead to the typical condition of the anthropoid vertebral column which now acts as a whole, its accompanying muscles supporting it as a pillar. The cervical spines are elongated with wide gaps between them to enable the head which is now poised on the first vertebræ to move freely on the trunk. In the dorsal region, the spines are imbricated to restrict the movement.

Again, as a result of the erect posture, the body-weight has come to be transmitted through the sacrum and then through the hip-bones which form arches to the thigh-bones. The pelvis has thus undergone profound alteration; the sacrum tends to be wedged in between the two iliac bones and becomes more curved in a cranio-caudal direction and involves the costal elements only. The symphysis has not to support the weight of the viscera and has been shortened, and the whole of the ischium has become free and a sub-pubic arch has been developed. The transmission of weight along the posterior part of the hip-bone, arches this part, and a subsidiary arch is formed in the pubic symphysis. The strong muscular pull necessary for the upright gait has led to a curvature of the bones and a widening

of the pelvis. The form of the external genital organs of both sexes is modified by the opening out of the symphysis. By way of adjustment to trunk uprightness, the disposition of the internal organs has also undergone alteration, all the viscera tending to sink towards the hind end of the body and to be suspended from the head end of the cavities rather than from the dorsal aspect.

The erect posture further causes the whole chest in breathing to fall backwards towards the vertebral column, and has gradually given rise to the broad flat chest seen in man in place of the narrow, pointed or rounded chest of lower mammals. The back bones have acquired a concave shape and the ribs in man are disposed obliquely and in circles. Whereas owing to the stability of the forelimbs in the lower mammals the muscles can move the ribs and costal respiration predominates, in man owing to his mobile forelimbs, these muscles fail to act and diaphragmatic respiration predominates. When exaggerated breathing is necessary the hands are fixed, and then only can the muscles act.

The conditions of active arboreal life which is inconsistent with nursing a large litter, necessarily resulted in the reduction of the family through the disappearance of multiple pregnancies, and led in the higher primates to consequent changes in the reproductive organs. The cornua of the uterus has been reduced and united, and has ultimately practically disappeared; the mammary glands—the development of which is in harmony with the number of offspring produced at a birth—have necessarily undergone reduction in number and alteration in position; and in the genital tract we have only the Fallopian tubes leading into the uterine body which now consists of a single median uterus for the accommodation of a single offspring, and this in its turn opens to the vagina and so to the exterior. With the perfection of the hand grasp in man, he has no need for the pair of inguinal or anchoring nipples which provide an extra hold for the lemur infant's mouth during its mother's excursions about the branches; and the pectoral mammary glands are the only functioning set in the human body.

In the earliest types of lower animals, the brain is a collection of ganglionic masses receiving impressions from the different sense organs. In addition to these, there is a lateral outgrowth of two small cerebral hemispheres, one from each side, which develop into the great cerebral cortex in the higher mammalia and in man, and here are blended all impressions that come by several channels.

It is in these cerebral hemispheres that some experts have supposed all the possibilities of human evolution to lie. Reflections from different centres find their way to the cerebral cortex. Judgment and memory become thus possible. The first to obtain representation was the sense of olfaction, and in primitive types of brain, these olfactory sense-impressions occupy nearly the whole cortex. Placed right in front of the animal, the olfactory sense-organs may be supposed to give the animal its first impression of anything with which it comes in contact. In mammals, taste, touch, hearing, vision—all gain representation, and the olfactory area is correspondingly reduced. The originally small olfactory pallium (arche-pallium) becomes augmented by new areas for other sensations and thus a neo-pallium is developed. In arboreal life, the recession of the snout region and emancipation of the forelimbs lead to other possibilities. Thus an object is felt, touched and moved in different directions with the hand and then smelt, and all these gain representation, and thus the olfactory area is reduced to a minimum. The sensations and, with them, the movements also are thus recorded in the brain-surface, as it were. With the emancipation of the forelimbs, the animal may feel and see the different parts of his body, and thus different parts of the body are all represented on the cortex,—both sensations as well as motions. All these are found in the lower mammals. Hand movements become gradually finer and complicated and the area for hand is gradually increased in the brain cortex. Physiological researches show that the hand-centre in the brain verges upon the region now known to be instrumental in acts of reason. An important advance in the use of the forelimbs will necessarily develop the hand-centre in the brain and is likely to stimulate the neighbouring intelligence centre, by the operation of the Law of Correlated Growth. The arboreal habit has further led to acuity and sharpness of the senses of sight and hearing, and these have gained increased pallial representation. The increased mobility of the head and recession of the snout region causing the eyes to come in front of the face, has also led to the dominance of the senses of sight and hearing. The head can be moved in any direction and consequently the eyes see everything, and sound from any direction can produce impressions. The educational adaptability of these two senses is increased, and the association of their impressions with each other and that of sight with touch becomes possible. At first the areas for hearing and vision were near one another, but owing to increased development of the cerebrum these have been separated by association areas. As an outcome of a series of elaborations of cerebral processes, the ideo-motor integration constituting the faculty of articulate speech was first developed in the dawning human being, and the development of the muscles involved in moving the tongue enabled him to produce

more connected and sustained sounds than mere yells, howls and exclamations.⁴

The arboreal habit, as we have seen, leads to the reduction of the family. In apes and men though the family is reduced, the childhood of the offspring is prolonged and during that time parental care becomes absolutely necessary. Nest-building is resorted to by some to protect their young. Thus parental or maternal care which is one of the manifestations of instinct is developed. This rearing up of the infant leads to the living together of parents up to the next breeding period, when another young is born, and thus the beginning of a family group is possible and is seen even among the gorillas and other apes. The offspring is cared for in human fashion. "If higher ideals of conduct are to be acquired as an evolutionary process, it is in the family circle and in the society composed of families that their rudiments must have been laid down and developed."

The development of the sense organs which are the channels by which education can come to the cortex, together with the development of the cortical areas, and their correlation and association are said to constitute the physical basis of *intelligence*. The neopallial cortex has been described as a mantle in which are situated the various receptive centres of different impressions, and the elaboration of the neopallium has been regarded as a growth of "association areas" interposed between the different reception areas. In "association areas" are formed, sorted, stored, and blended memories and experiences derived from the several senses. There is a development of the frontal *silent area* in man in front of the motor areas. This prefrontal cortical area is generally regarded as the seat of Memory, Imagination, Judgment, and of the other higher mental faculties and co-ordinated ideas. Dr. Wood Jones suggests that it is not impossible to imagine that an area which is an association or extension of the motor area, or what he would term the "pictured movement" area, might be connected with a further elaboration in the form of idealization—of pictured movements. As Dr. Wood Jones puts it, "The animal without a neopallial kinæsthetic area performs all its actions in the absence of any pictured consciousness of the action. An animal with a kinæsthetic (motor and sensory) area performs actions of which it has a definite mental pictured conception:—*It knows what it is doing*. An animal with a developing prefrontal association area has, in addition, memories of its past actions. *It knows what it is doing and remembers what it has done*. An animal with an elaborated

⁴ Broca first discovered that the inferior frontal convolution of the left side of the brain was connected with speech.

prefrontal area has, in addition, the faculty for building up pictures of possible future actions. *It knows what it is doing, remembers what it has done, and it can estimate what it might do*'.⁵ Thus, according to this view, are the foundations of consciousness, conscience, and ideals of conduct laid.

It is not, however, the bodily adaptations alone that have sufficed to create possibilities of primate brain development; for, in some mammals, such as the *Metatheria* (Marsupials), arboreal habit does not appear to have led to cerebral development. It is the development of a *corpus callosum*, a connecting band between the two cerebral hemispheres that, according to Dr. Wood Jones, forms the index of neopallial perfection; and bodily adaptations combined with neopallial development is believed to lead to the evolution of the human brain.

Thus the attainment of the erect attitude together with the "opposition of the thumb" would seem to be the starting-point of humanity. The head and trunk being nicely balanced on the vertebral column, the hands were set free for manipulative purposes and man became a tool-making and tool-using animal. The deeper convolutions of the brain brought greater intelligence into play, and the hands and brains combined, hastened man's further progress through intelligence and mechanical skill. The perfection of the human hand as a tool-making and tool-using instrument, the adaptability of the vocal organs to the expression of thought, and the immense development of the intellectual and emotional faculties resulting mainly, if not wholly, from his more highly organized brain capable of co-ordinating the impressions of his senses, of understanding his physical and social environments, and of utilizing, modifying, resisting and even, in some measure, controlling and ruling them, placed Man not only at the head of the grand series of organic nature, but, as Wallace says, placed him "apart, as in some degree a new and distinct order of being".

Wallace, however, maintains that although man's physical structure has been developed from an animal form by natural selection and variation, his mental nature even though developed *pari passu* with it, has not been developed by the same causes only, but requires some other influence, law or agency to account for certain portions of it. The law of natural selection, Wallace points out, ⁶ "can act only on useful or hurtful characteristics, eliminating the latter and keeping up the former to a fairly general level of efficiency" so that "the characters developed by its means

⁵ *Arboreal Man* (1918), p. 195.

⁶ *Darwinism* (Macmillan, 1911), pp. 461, etc.; see also *Natural Selection and Tropical Nature*, p. 202.

will be present in all the individuals of a species, and, though varying, will not vary very widely from a common standard" (the amount of variation not exceeding one-sixth or one-fifth of the mean value). Thus, in the speed of running, in bodily strength, in skill with weapons, in acuteness of vision or in power of following a trail, all savages are fairly proficient, the differences not exceeding the limits of variation referred to above; whereas it is altogether different in certain specially developed faculties of civilized man such as the mathematical faculty, the musical faculty and the artistic faculty which are highly developed only in a small proportion of individuals, and the variations in the amount of the faculties in question in different men are enormous. Wallace regards the gigantic development in certain civilized men of such special faculties as these as wholly unexplained by the theory of natural selection, for, says he, these have no immediate influence in the struggles of savage man with the elements, or with the wild beasts, or of tribe with tribe, nor on the early migrations of man or the success of tribes, races or nations in their struggles for supremacy. Such special faculties in man, according to him, could not have been derived from his animal progenitors, but may be best explained "as being of a spiritual essence or nature, capable of progressive development under favourable conditions". "On the hypothesis of this spiritual nature superadded to the animal nature of man", says Wallace, "we are able to understand much that is otherwise mysterious or unintelligible in regard to him, especially the enormous influence of ideas, principles and beliefs over his whole life and actions."⁷

Anthropologists in general, though recognizing the great psychological gulf which separates man from the rest of the animal world, reject Wallace's theory as an unnecessary assumption unsupported by any evidence.⁸ A few, such as the distinguished French anthropologist Quatrefages, however, though regarding man's entire organization, physical as well as mental, as the work of evolution, would make an exception in favour of the faculties of conscience and religion. The trend of authoritative anthropological opinion is, however, to trace man's intellectual and psychical, including moral and spiritual, development on some such lines of evolution as the following: The conversion of the upper limbs into true hands and their movements as such would, as I have already noticed, originally lead to higher brain-development. Whereas the cranial capacity of the average European is 1,500 centimetres, that of the gorilla, which is a larger

⁷ Darwinism.

⁸ See Robert Munro, *Prehistoric Problems*, p. 103, and Sir William Turner, *Journal of Anatomy and Physiology*, Vol. XXIX, p. 436.

animal, does not exceed 590. With the first use of a piece of wood or a natural stone as a missile to defend himself or attack his prey, there would arise a further incentive to higher brain-development. Experience would soon teach him the advantages of a particular form of club or stone which he would then collect and, when none is found ready-made or within easy reach, he would seek to shape some for himself. Although like him, the ape, too, could pick up and use a stone or stick, man by degrees recognized that a more effective weapon could be obtained by sharpening or shaping the stick or stone. This power to shape and use an efficient weapon was perhaps man's first forward step in mental progress. This momentous invention would soon lead to a consideration of the comparative merits of different specimens of such 'weapons', and thus to some sort of abstract reasoning. In this way the functions of the head and the hand would act and react on each other, and this interaction would develop a larger brain and higher mental powers.

In fact, it is according to the materials man has used for his tools and weapons that science, as you know, divides the history of man into different epochs or rather stages. We thus speak of the palæolithic or Old Stone Age, the neolithic or New Stone Age, the Copper Age, the Bronze Age, the Early Iron Age, and the Later Iron Age. And the comparative method of enquiry appears to indicate that, generally speaking, with occasional deviations due to borrowing of cultural traits or intermixture of races and cultures, the history of human culture in different regions follows more or less the same or similar lines of development and stages of advance in widely separated periods of time. Some of the comparatively more stationary or primitive groups, such as the original inhabitants of Tasmania, the Red Indians of North America, the Australian Blacks and African Negroes, were still in the Stone Age when the Europeans first discovered them.

A no less important conquest over Nature was achieved by early man by his discovery of fire and its uses. And the knowledge of fire necessarily brought in its train a considerable improvement in primitive man's arts and industries and material comfort and led to the differentiation of man's work and the woman's. Man became the procurer of food, as the hunter, fisher and warrior, and the woman became the cook and keeper of the hearth and home, and, later, the harvester and miller, the mat-maker, the basket-maker, the weaver, and so forth. Whether the phenomenon of a flash of lightning setting on fire a dry forest tree, or the accidental production of fire by the friction of one tree against another on a summer day in a tropical forest, or some other unforeseen circumstance, first revealed the knowledge of fire to man, will ever remain

a mystery. The primitive method of the production of fire by friction is still practised by several backward tribes in India and elsewhere. The Orāons of Chōtā Nāgpur, besides producing fire by the friction of two sticks, have been known to practise a ceremonial method of putting out old fire and taking in new fire from a stack of hay or straw when it is accidentally set on fire by lightning. Although they have no legend like the Greek myth of Prometheus bringing down fire from heaven, the Orāon regards such "lightning-fire" or *bajar-khatarka-chich*, as he calls it, as sent by Heaven.⁹ And indeed the worship of Agni by the primitive Indo-Aryans, the tending of the sacred fire by the vestal virgins in ancient Rome, and fire-worship among other peoples may perhaps be traced back, either to primitive man's awe of the supernatural or the tendency of primitive man to regard as sacred such objects or phenomena as he finds particularly helpful or harmful but not always amenable to control, and weaves his religion or superstition around them.

As for religion, orthodox anthropological opinion lays down
Evolution of that the phenomenon of dreams, supported by
Religion. the analogous phenomena of trances, hallucinations, shadows, reflections, clairvoyance and similar other phenomena, first suggested the notion of an indwelling soul or spirit in man; and this idea of spirit was subsequently extended to the obscure forces of Nature and to other objects regarded as specially powerful for good or evil. The echo may also have suggested the existence of an indwelling spirit in hills and rivers. This animistic stage would, however, appear to have been preceded by a pre-animistic one in which a vague mysterious virtue or force would be associated with certain objects and phenomena and would produce dim impressions of the awful and occult and a vague sense of wonder mixed with fear. Out of this primitive "Supernaturalism" both magic and religion would appear to have been evolved. It was the needs of his body—his quest for food and warmth—that would appear to have first led man to think, and to evolve a religious system, as it had led him to work, and to invent and inaugurate his material progress. Where man found himself powerless to cope with certain mysterious forces and powers of nature whose presence inspired him with a vague feeling of awe, and on whose favourable disposition his food-supply and physical well-being were supposed to depend, he began to devise means for conciliating or controlling them and thereby avoiding ill luck and securing good luck. And in this way arose his earliest religion or spiritism (psycholatry) which gradually developed variously along divergent lines into

⁹ S. C. Roy, *Orāons of Chōtā Nāgpur*, pp. 170-171.

animism and ancestor-worship, nature-worship and phallus-worship, fetishism and idolatry, totemism and animal-worship and the belief in wer-animals (such as the *ulat-bāgha* of certain Chōṭā Nāgpur tribes), besides magic, witchcraft and other superstitions. Polytheism, higher pantheism and monotheism were among later developments of the religious idea. The different forms in which the religious idea and religious practices, and, in fact, all phases of culture appear in different regions and among different human groups, and the divergent lines in which they have developed are determined by diverse causes not the least amongst which are racial miscegenation, and transmission, borrowing and blending of cultural traits.

The earliest traces of a belief in spirits and an after-life, may perhaps be seen in the cave burials of the late palæolithic period in Europe which appear to suggest funeral rites. The painted animal figures discovered in the European caves of the earlier Magdalenian epoch have been supposed to represent totemic or tribal symbols exercising a magic influence and thus to imply the existence of religious ideas. In India,¹⁰ similar cave-paintings have been discovered in the Kaimur range in district Mirzapur, and in certain hills near Singanpur in the Raigarh state of the Central Provinces. No definite statement as to their antiquity, however, appears to be justifiable until further investigation reveals more tangible evidence than mere similarity of form or technique. The dolmens and barrows of the neolithic era of Europe (to which a duration of from 50,000 to 100,000 years has been ascribed, point unequivocally to a definite belief in an after-life. Mortuary urns and other evidences of a primitive belief in an after-life are also afforded by similar dolmens and cromlechs in Chōṭā Nāgpur and the Deccan in India, but their age has not yet been ascertained.

Magic and religious propitiation are neither the only nor indeed the primary purposes to which the **Evolution of Art.** origins of art have to be traced. The art-impulse, or the original inducement to artistic production, is, as Hirn¹¹ explains, the natural impulse of man to manifest his emotions and thereby to enhance his feelings of pleasure or relieve his feelings of pain not only by the direct action of giving vent to such feelings, but also by the "enhancing or relieving power of social expression"—by awakening a kindred feeling in other human beings who witness the manifestation.

¹⁰ *Journal of the Royal Asiatic Society*, 1899, p. 89, *Journal of the Asiatic Society of Bengal*, LII (1883), part II, No. 1, pp. 58ff., *Journal of the Bihar and Orissa Research Society*, IV (1918), pp. 298ff.

¹¹ Yrjö Hirn "The Origins of Art" (1900); see A. C. Haddon, *Evolution in Art* (1895).

Thus the simple state of emotional excitement, such as a festive mood or martial enthusiasm or sexual exaltation comes to be expressed by regulated gestures or regulated sounds,—by dances, songs, or pantomimes. Besides the stimulation of the spirit or vital energy which makes life's work easier to perform, other purposes which the artistic effort of primitive man as well as that of his more civilized fellow-man serve are the sensuous enjoyment of the beauty of form, line and colour—art for art's sake—leading to the production of the simple decorative figures on primitive pottery and other artifacts, and, later on, of pictures, groups, patterns, etc.; the communication of our knowledge of nature and life and the suggestion of ideas by word or image of some form or other, beginning from simple pictographs, and developing into phonograms, emblems, tribal signs and symbols; the display of wealth and power manifested in the production, at first, of personal ornaments and ornamented useful objects and, later, of money and objects emblematic of power or status; and last, but not least, the exercise of supposed sympathetic influence known as magic, and the propitiation of the spirits of the deceased and other unseen powers whose favour or disfavour is deemed to be of paramount importance. Such propitiation constitutes Early Religion.

Thus early man's endeavours to understand and explain the various natural phenomena surrounding and affecting him, helped forward his intellectual evolution, on the one hand, and his religious evolution, on the other. His intellectual efforts came to be embodied in a growing body of traditional legends and myths, ballads and songs, riddles and proverbs, nursery-rhymes and similar other "survivals" and "vestiges" comprised in the general designation of "folk-lore."

Hardly less important than the evolution of art and religion is the evolution of the moral sense or conscience. Darwin's suggestion that the conflict of instincts, and the survival of groups obeying the instincts that made for group-preservation would, in a long process of evolution, link the socially useful with the morally right, has been endorsed and followed by such thinkers as Leslie Stephen, Hobhouse, Westermarck and others.

According to Darwin, aboriginal man lived in small communities, each with one or more wives, whom he jealously guarded against all other men. This theory has been generally accepted by anthropologists as the most likely theory of the original basis of human society. The horde-theory of the origin of society advocated by such writers as Morgan, McLennan and Bachofen, and hypo-

theses concerning promiscuity and group-marriage and the like, appear to rest on the slender basis of but a few stray institutions and customs supposed to be survivals found amongst certain existing savages. Atkinson's¹² intermediate hypothesis of the primitive horde as a single family from which the young males were driven by the jealousy of the male parent as soon as they had attained maturity, might appear to be more plausible. A more or less durable connexion between a male and a female lasting beyond "the mere act of propagation till after the birth of offspring", which Westermarck¹³ calls marriage in a wide sense, is found even in some of the lower animals. And marriage proper in the sense of "an exclusive relation of a man with one or more women, recognized and supported by custom and, where law exists, by law"¹⁴ is found to exist amongst the lowest savage tribes, such as the Veddas of Ceylon, the Andaman Islanders and the African Bushmen. It is only in tribes a little higher in the cultural scale (generally those with totemistic matrilineal clans or patrilineal "gentes")¹⁵ that we find the kin-group overshadowing the family. The economic value of the female to primitive groups would appear to indicate that the husband could become independent of his wife's kinship-group and become the actual head of his family only by forcible abduction of the bride in the beginning, and, later, by payment of compensation in the shape of service, or the bride-price or exchange of another female—all of which methods of securing a wife are in vogue amongst the aborigines of Chōtā Nāgpur and other parts of the world. There would thus seem to exist good reasons for assuming that the family consisting of father, mother and offspring formed the original basis of primitive society. And such domestic virtues as love, self-denial, courage and sympathy would appear to have been originally called forth by the physical needs of the helpless children, and served to knit together the family in increasingly closer bonds.

And as families aggregated into kinship-groups, clans or gentes, and these in their turn into tribes, social virtues calculated to subserve the well-being of these groups by regulating the relations between kinsmen and tribe-fellows would necessarily gain recognition.

The obvious needs of social order for the maintenance of communal life led to customs which came to be the recognized

¹² *The Primal Law* (1903).

¹³ *History of Human Marriage* (1894), p. 137.

¹⁴ Avebury, *Marriage, Totemism and Religion*, 1911, p. 2.

¹⁵ This distinction in the use of the terms "clan" and "gens" (*pl.* "gentes") as referring to matrilineal and patrilineal groups, respectively, is observed by American anthropologists.

moral code of the community, at some stage in the dim past of man's early social history—perhaps when authority came to be vested in the clan chief or tribal chief who as the medicine-man and magician would be supposed to have commerce with the deified tribal ancestors and other spirits and to know, reveal, and enforce their wishes and commands. These commands would in the beginning probably take the form of taboos or prohibitions, the infringement of which would be regarded as entailing mystic evils and divine punishment. In this way, superstition would appear to have strengthened the respect for marriage, private property, human life, and government, the main pillars, as Sir James Frazer says, on which all Society is founded. The feeling of moral or religious obligation thus arising as a variation has maintained itself by its social utility, and thus, law, morals, conscience and the sense of equity have linked themselves with group-purpose. Thus heredity, environment, social tradition and the religion of a people, determine their moral code, and a legal code follows as a body of sanctions to punish transgressions against the good of the community as embodied in social tradition.

Such is a brief sketch of the probable earlier steps of the intellectual, social, moral and religious evolution of Man which the orthodox or evolutionary school of Anthropologists seeks to reconstruct by working back from the known customs and institutions, traditions and beliefs of the lowest existing savages, as also from certain surviving relics of such customs and beliefs embedded as fossils among more highly evolved races.

As for the relations between civilization and man's physical characteristics, analogy from the characteristics of the existing backward races of the world would appear to corroborate the inference, suggested by osteological remains and other considerations, that generally speaking, early man was, on the average, less than man as we now know him.

Stature. First, as to stature. In spite of the markedly tall stature of the uncivilized Patagonians who measure from six to seven feet in height, ethnological observation would seem to indicate some connexion between savagery and inferiority of size; for, with some notable exceptions, the average primitive man is somewhat shorter than the average civilized man. Perhaps local conditions may have had their share in affecting the growth of these tribes who were thrust into more inhospitable localities by the more successful races. Or, perhaps, the differences of stature and strength were already developed by the action of food and environment; and superiority of size, thus acquired, ensured the success of the physically superior races. The extreme view

held by a few anthropologists that the pygmy tribe represents an early stage in the evolution of the larger varieties of mankind is not, however, supported by palæontological evidence. And the weight of anthropological opinion is almost equally balanced between two alternative views, namely, one that regards the pygmies as varieties of their taller and bulkier neighbours and congeners, stunted through the action of environment, and the other view that regards them as constituting a distinct type of mankind descended from a collateral ancestral human stock, which has become modified in different areas. In the absence of experimental research, no satisfactory solution of the problem is possible.

As with stature, so with other morphological characters. **Other physical characteristics.** Thus, the lower limbs of the backward tribes are generally found to be comparatively smaller than those of civilized peoples. Certain hill tribes of India and other tribes elsewhere

are found to have comparatively less developed legs, inferior in massiveness, and shorter relatively to the length of their bodies, as their forearms are relatively longer. And it is inferred that these characters more adapted to climbing habits are reminiscent of our arboreal ancestors. An approach to the larger size of the jaws and teeth in most of the skulls of early man may be seen in the comparatively large jaws and teeth of various inferior races of to-day such as the Australian natives and the Negroes who are markedly prognathous. Notwithstanding the theory of the non-heritability of acquired characters, this trait would appear to have been conditioned to some extent by the mastication of coarse uncooked flesh and other tough food. Herbert Spencer suggests that the greater use by early man of his teeth in place of tools may also have contributed to this end, and "diminution of function has brought diminution of size both of the jaws and of the attached muscles".¹⁶ To the quality of their food we have apparently to refer the ape-like abdominal development of certain primitive tribes such as the Akkas. The swelled stomach of the savage, particularly of his children, is a matter of common ethnographical observation. When primitive man depended for his food mainly on the chances of the chase, there was a decided advantage in the ability to consume and digest a large quantity, when available, so as to make up for intervals of semi-starvation. This circumstance as well as the need for digesting roots, fruits and vegetables and inferior animal food such as insects and worms, in large quantities, so as to yield the amount of proteid fats and carbo-hydrates required for the sustenance of the body would lead to a relatively larger alimentary system. Ethnological

¹⁶ *Principles of Sociology*, Vol. I, p. 44 (London, 1893).

observation appears to indicate that as in stature and muscular development so also in physical strength and nervous energy, the modern savage and semi-savage tribes are inferior to more civilized races. Although relatively hardy, as required by a life very much at the mercy of its environment, they are found to be inferior in sustained power of endurance. And it is inferred that early man, like his modern representative—the latter day savage—was, on the average, inferior in the size and structure of his body to modern man.¹⁷

As for the emotions, experimental psychology shows that savages are emotionally more sluggish and obtuse than civilized man, whose higher training, however, enables him to keep cool. And early man, we may reasonably infer, was still more deficient in emotion than the modern savage.

I have now finished my hasty and imperfect survey of the probable early stages of the long series of evolutionary changes by which man has risen to his present mental and physical condition. The initial stages of his evolution reaching back to the Tertiary era, can, as we have seen, be only guessed with such feeble guidance as Zoology, Palæontology and Comparative Anatomy may furnish.

The processes of Variation and Selection through the principles of "natural selection," "sexual selection," "correlated development," "segregation," "organic selection," "organic memory," and perhaps, to a limited extent, "use-inheritance" referred to in my third lecture, as also perhaps some other internal psycho-physiological laws of development acting reciprocally with the external stimuli of evolution, must all have operated, in varying degrees of participation, in producing the fluctuations and mutations which in course of ages combined to fashion forth from Nature's laboratory the finished product—MAN.

As we can infer from the known facts of the course of human progress, the evolutionary changes of our first forbears was not a series of forward leaps—"a simple procession of forms leading from ape to man". There must have been an irregular alternation of slow marches, temporary halts, and even an occasional retrogression as well as forward leaps. Such changes have been aptly described as a "slowly-augmenting complex of

¹⁷ It must be noted, however, that with respect to most present-day backward races, it can hardly be said that their physical characters are, on the whole, less highly developed than those of the more advanced races. And even, as for ancient man, the Cromagnards, at any rate, appear to have been physically superior to many modern peoples. Indeed, certain communities in India and elsewhere would seem to indicate that intellectual and social progress may occur inspite of physical deterioration.

zigzags." But the prevailing direction has not been missed. That direction was from the beginning, one from the brute to the man—from the feeble-brained soul-less animal to the large-brained human being with great intellectual, moral and spiritual possibilities.

A comparison of the few skeletal remains of early human forms discovered in different geological strata, where a fortuitous combination of circumstances preserved them for posterity, unmistakably points to this direction. The greater the geological antiquity of such a skeleton the greater is its approximation to more primitive forms. As Dr. Hrdlička epigrammatically puts it, "Animalism varies with antiquity." This, of course, has reference only to prehistoric man. Thus, generally speaking, *Pithecanthropus* with his powerful jaws, chinless face, flattened brain-case and small brain, exhibits more ape-like features than the smaller-toothed, chinless Heidelberg man, and the Heidelberg type shows more animal features than the Neanderthal man with his comparatively larger brain and shorter and thicker thighbone. The Neanderthal man, in his turn, presents a brute-like appearance when compared to the Cromagnon man with his elevated brain-case, slight brow-ridge, reduced lower jaw, smaller teeth, and his tall stature and fine physique approaching that of the modern Sikhs of the Punjab. The Australian Black, who was isolated from the rest of the world probably through an early geological catastrophe represents a type slightly nearer the animal than modern man. The slenderness of his vertebræ, the undeveloped curvature of his vertebral column, the large size of his molar teeth and the traits of his foot reminiscent of arboreal habits, would seem to take us somewhat nearer to the generalized Proto-Man. In this way by a series of progressive differentiation and specialization, the brute has risen to the state of man. As the few osseous remains of early man point to the gradual evolution of his body, so also do the numerous industrial remains unearthed from cave-shelters, ancient ruins, rocks and graves, naturally arrange themselves, broadly speaking, in a progressive series in type, technique, artistic skill and æsthetic taste, and testify to the gradual evolution of the human mind and soul through the ages.

Truly does Darwin in the closing paragraph of his *Descent of Man*, observe—"Man may be excused for feeling some pride at having risen to the very summit of the organic scale, and the fact of his having thus *risen* instead of having been aboriginally placed there, may give him hope for a still higher destiny in the distant future."

LECTURE V.

Man's First Home and Early Migrations.

IN my last lecture I endeavoured to trace the steps by which, in course of ages, through the combined influence of various external and internal causes and conditions, Pre-Man, in addition to his already acquired erect posture, a habitually bipedal locomotion and the opposable thumb, shorter arms, developed a larger and more complexly convoluted cerebrum accompanied presumably by growing intelligence, the rudiments of articulate speech and perhaps also a rudimentary moral sense—and thus became the first generalized “Proto-Man”. We have also seen in a previous lecture some reasons to infer that the first appearance of Proto-Man probably took place in Pliocene times. In the present lecture we shall enquire first as to *Where* or in what particular part or parts of the earth that most momentous event probably took place and then as to the probable routes the ancestral human groups followed in their early migrations to the different regions where they variously specialized into the proto-types of the three or four primary Human Races.

As fossils and industrial vestiges of the zoological suborder Anthropoidea to which Man belongs first appear in geological deposits of the late Tertiary epoch, the anthropologist studies the successive changes in the configuration, climate, fauna and flora of the earth in the different ages of that epoch to secure a basis for his enquiries regarding the time and place of man's origin, and his first migrations. I shall accordingly begin with a brief account of the results of geological and palæontological researches on these successive changes of the earth.

Geological deposits reveal the existence up to about Eocene times of a vast Eurasian sea stretching right across the heart of the Old World from the present sites of Japan and China in the east to the Spanish Pyrenees on the west and from the sites of the present Alps and Caucasus ranges on the north to those of northern Africa, Arabia and Peninsular India on the south. The great upheavals at the end of the Mesozoic period resulted in the formation of isolated basins

to the north of this central sea affording favourable conditions for the growth of a varied flora and fauna of advanced types. The present sites of Northern India including the great Indo-Gangetic plains, Persia, Asia Minor, Greece, Italy, Switzerland and Spain were all under this central sea. To the south of this central sea, Peninsular India, Central and Southern Africa together with the Laccadives, Maldives and the Seychelles and the Madagascar formed a vast Indo-African continent. This Indo-African continent, named the 'Gondwana Land' by Indian Geologists, probably extended at one time right across the Atlantic up to Southern America near the present site of Brazil. Geological evidence, in particular the striking similarity of the late Palæozoic and Mesozoic (*Glassopteris*) flora of India with those of Australia, South America and South Africa, further points to the former existence in late Palæozoic and early Mesozoic times, of a neighbouring Austral continent which comprised Australia, Tasmania, New Guinea, and the other islands of the Archipelago and probably extended as far as New Zealand.

Along the shore of this central sea were numerous wide bays to the north, which divided Northern Europe into several separate basins of deposit, where the fauna and flora had independent development. The greatest and the most colossal disturbances of the earth's crust began with the Tertiary period, and the floor of the sea was raised at places in the northern continent into lowlands with lagoons, estuaries and lakes, suitable for abundant vegetation of a new type—that of dicotyledonous angiosperms—the evergreen and hard-wood trees of recent times which became predominant in the Upper Cretaceous age and began to replace the older cycads, conifers and ferns. Mammalian life began under very favourable conditions of a comfortably warm climate and increased in diversity of type. Insects, millipedes, lizards and snakes were also abundant. At the commencement of the Tertiary period, when mammals first began to spread widely over the globe, they were all very small in size, and hardly distinguishable into groups or orders. They gradually increased in size of body and brain so that by Eocene times some of the low-brained hoofed animals attained their maximum size and then became extinct. Remains of lemurs have been found in the Lower Eocene and of monkeys and tapirs in the Middle Eocene deposits of North America, where the Eocene sea overlapped part of the United States coast-line from New Jersey southwards and rolled over what is now Central America and covered the coast-ranges of California and Oregon. The remains of olives, cinnamon, camphor, figs, breadfruit, magnolia, walnut, palms, and other large-leaved monocotyledons in Eocene deposits indicate a tropical climate not only in the southern hemisphere but also in the northern, even

well within the Arctic circle. With currents of warm water from the tropical ocean flowing right through the centre of the two hemispheres, the climate, though mainly tropical, must have been genial enough on the seashores and the banks of the great rivers and bays to have enabled the common ancestors of the *Hominidæ* and the *simiidæ* to live in comfort, particularly by the rivers along the shore-line, subsisting partly on shell-fish and partly on nuts, fruits, insects, birds' eggs and other minor eatables. Like most dwellers of tropical regions, they would naturally be principally plant-feeders.

The Oligocene and Miocene ages that followed were periods of **Oligocene and Miocene.** dislocation and disturbance accompanied by volcanic outbursts and great changes in the terrestrial crust. They witnessed the development of the present distribution of land and sea and the final upheaval of most of the great existing mountain chains of the globe. The bed of the Eocene nummulitic sea was upheaved into a succession of great mountains, in which portions of the sea floor are now found, even at an altitude of 16,000 feet above sea-level. The upheaval of these mountain chains gave rise to corresponding depressions, and the process of denudation and sedimentation went on with renewed vigour creating fresh disturbances in the already unstable equilibrium of the crust. Adjustments and readjustments followed, by which successive deposits were raised above the sea floor and into the outer flanks of the great mountains.

So much of the Indo-African and Austral continents as still remained suffered various cataclysms. Great volcanoes sprang up both in the New and the Old World. Vast floods of lava streamed forth over the land and varieties of rocks were produced. In spite of these, the land connexion of these continents with the rest of the habitable globe probably remained sufficiently unimpaired at certain points to afford easy passage to and from other regions. The central sea had not yet receded far enough to connect the main Himalayan area with Peninsular India.

With these changes in the earth's crust the climate underwent corresponding changes. The tropical climate of the Eocene gave place in most places to a temperate climate in the Oligocene and Miocene. The palæontological evidence of the Oligocene strata reveal the existence of a group of mammals with body and brain more developed than among the Eocene mammalia and attaining their maximum development just before they became extinct. There is also, as we have seen in a previous lecture, evidence to indicate that during these ages the *simiidæ* or anthropoid apes had diverged from the common stock; true apes, with a higher brain development than that of any previously-existing mammal, having

attained almost their present size by about the middle and towards the end of the Miocene ages. Dr. Pilgrim of the Indian Geological Survey has shown that the discovery of a number of fossil teeth and other fragments in Northern India points to the existence of various kinds of apes in the Miocene forests of that region before the final uplift of the Himalayan range at the close of the Miocene and the beginning of the Pliocene ages.

The late Joseph Barrell of the Indian Geological Survey made the suggestion that it was probably during the upheaval of the Himalayan range at the close of the Miocene and beginning of the Pliocene ages, that Man was first differentiated from the *Anthropoidea*. With the lowering of the temperature as the land rose, some of the apes which had up till then lived in comfort in the warm forest would be shut off in the north of the upheaved area. As the warm forest would now be replaced by comparatively dry plains, the apes could no longer migrate southwards, and those that survived would necessarily become adapted for living on the ground and acquire carnivorous in place of frugivorous habits. With the gradual increase in the convolutions of the brain and in the size of the body, these ground-apes would tend to become man.

It would rather seem reasonable to infer that the original precursors of the *Hominidæ* had probably specialized and separated from the common stock of *Anthropoidea* by Oligocene times and began to further specialize to adapt themselves suitably to the varying environment and keener struggle for existence introduced by the colossal disturbances in the crust of the earth and the consequent changes in moisture and temperature and corresponding changes in the flora and fauna in late Miocene and early Pliocene times. And in this way, Pre-Man would probably develop into Proto-Man in Pliocene times.

As the tropical forests of earlier geological times gradually gave place to scattered thickets or scrub and open stretches of steppes and the changed character of the plants became unsuited to an arboreal animal, Pre-Man was probably forced to leave the trees and began to habitually walk on his hind legs. The flora and fauna of these thickets and grass lands would also powerfully influence his evolution. The gradual disappearance of the forest and the presence of fearful animals like *machærodus*, *elephas antiquus*, and *rhinoceros tichorinus* would prevent him from drifting back to the fruit-eating arboreal existence of the orang-outang and the gorilla. To protect himself from his fearful quadruped neighbours, he would naturally make use of twigs and branches of trees and probably devise rude wooden clubs and gradually take to fashioning the earliest rough stone weapons. If the

eoliths discovered in deposits of these ages were chipped by him, we may infer that our semi-human precursor, like the modern savages of the South Sea Islands, occasionally killed small game in addition to collecting nuts, fruits, birds' eggs, insects, turtles, and other miscellaneous trifles. In any case, the eoliths if made by him could have been of use to him in breaking nuts, turtles and the like. But he could yet be hardly called man.

Mammalian life obtained its highest development during the Miocene and, particularly, Pliocene ages, its special characterization being troops of elephants, rhinoceros, hippopotamus, cave-bear and other herbivora which roamed in large herds in the primeval forests. There were also some colossal ruminants including the giraffe and gigantic giraffe-like creatures called *Heladotherium*, a form intermediate between the giraffe and the antelope. Besides these there lived various ancestors of our present-day animals. The *machærodus* or the sabre-toothed tiger was a predominant carnivore of this period. In the Pliocene deposits of Northern India, fossil remains of several kinds of elephants comprising stegodon and five varieties of mastodon, three kinds of rhinoceros, three kinds of hyenas, several kinds of *felis* (lion, tiger, etc.), three kinds of the ox besides the horse, bear, bison, buffalo, and hippopotamus have been discovered.

As mammalian life was developing during these ages and was predominant, Pre-Man would naturally collect food by day and sleep at night on branches of trees in some sort of a primitive shelter made by intertwining twigs and boughs. As we have seen in the fourth lecture, there is some anatomical evidence pointing to the original arboreal habits of the precursors of the Hominidæ.

The final plication (folding) and uplift of the meridional mountain chains in the Old World was completed during the Pliocene age. Topographical changes were still going on and the sedimentation into what remained of the Central Eurasian sea was raising it to what subsequently became the great Gangetic plain connecting Northern Asia with Peninsular India.¹ Etna, Vesuvius and other volcanoes came into existence during this age. A marked refrigeration of the climate set in. The tropical vegetation of the Eocene and sub-tropical vegetation of the later ages gave place to plants of

¹ The newly emerged Himalayan region now still further drove back the Ocean which had already by Miocene times become restricted to Sindh and Beluchistan on the west and Burma on the east. And the mastodon and other huge mammals began to roam at large in the Pliocene jungles of Burma and the Himalayan foot-hills, and Proto-Man might wonder at will from India, through Burma to Malaysia or from Malaysia to India and to other parts of the globe. The Eastern Himalayas appear to be far more ancient than the rest of the range and appears to have been connected from very early times by a continuous chain of hills which included the hills of Assam, the Rājmahal hills and those of the Eastern Ghats which probably once formed the eastern boundary of the submerged Gondwana (Indo-African) continent.

colder climates,—the older flora, on which the herds of herbivores lived, migrating southwards and taking with them the important fauna of the period. Fossil remains of *elephas antiquus*, *elephas stegodon*, and hippopotamus have been discovered in early Pleistocene deposits of the Nerbudda valley in India.

With the increasing refrigeration of the climate which finally gave place to the Ice Age, the large mammalian fauna were driven to a more congenial environment, and only such forms as could adapt themselves to the varying conditions lived in the old areas. The rest either perished or were driven further and further to the south. The flora on which the herds of herbivores lived had preceded the fauna southwards. Our Pliocene ancestors had to take recourse principally to animal food inasmuch as suitable vegetable food grew increasingly scarce.² The diversified forms of mammalian life which had attained their zenith during the Pliocene were during the Pleistocene or the Ice Ages more or less extinct. Man and such other animals as could adapt themselves to an extremely cold environment alone survived the great changes in the climate.

Until about the end of the Pliocene, the Indo-Malaysian and the Austral regions would appear to have extended much further than their present limits. What is now Great Britain then formed part of a continent that stretched far into the Atlantic Ocean; wide valleys covered the present sites of the English Channel and the Irish Sea as well as the Adriatic Sea. The present site of the Mediterranean Sea was covered by two lakes, the land spaces between which connected Africa with Europe across the Strait of Gibraltar and also across the present Ægean Sea, while the American continent was joined through the Faroes, Iceland and Greenland with north-west Europe and across the Behring Strait through Alaska with North-East Asia. Geologists are agreed that this land connexion between Asia and America subsisted till the earlier part of the Pleistocene age.

We have seen that the geologic ages from Oligocene onwards were ages of increasing coldness and of great physical changes. This would naturally lead to rapid biological evolution and differentiation and a gradual migration of animal and plant life southwards. Although in Miocene and early Pliocene times we meet with anthropoid apes in southern Europe and the Siwalik Hills—and Miocene Siwalik fauna are met with in the Punjab, Sind, Siam, Perim Island, the Malay Peninsula, Java and even as far

² Some experts are, however, of opinion that the general plan of the alimentary canal and the digestive system of the primates point mainly to carnivorous rather than herbivorous habits in the proto-primates. Their struggle for food would help the growth and elaboration of the brain.

north-east as Shanghai—it was probably towards Mid-Pliocene times that they began to migrate to more congenial climates further south. The lemurs and the anthropoid apes are now all found only to the south of the great deserts of Africa and Asia,—in Africa only to the south of the Sahara and in India south of the desert of Rājputānā,—and also in the Malay Peninsula and the great Oceanic islands. The lemurs are mainly found in Madagascar and may be divided into the African, Madagascar and Asiatic groups. Of anthropoid apes, the gorilla and the chimpanzee are entirely African, all the species except two being found either in west African or Congo forests; all the thirteen species of the gibbon have their habitat either in Indo-China or in Malay regions; and the orang-outang occurs only in the islands of Borneo and Sumatra.

In this connexion it is interesting to note that the most ape-like races of Man, such as the Australians and the now extinct Tasmanians, as also the most primitive and infantile pygmy races such as the Negrillos of the equatorial forest of Africa (with a stature of from 4ft. 4½in. to 4ft. 9¼in.), the Negritic Andamanese (4ft. 10in.), the tribe of black dwarfs said to have lived until very recently on the Cardamom Hills in the Deccan, the Semangs (4ft. 10¾in.) of the Malay Peninsula and Sumatra, and the Aetas of the Philippines (4ft. 10in.) are all met with only in these southern regions. Finally, it was in the island of Java on the edge of the Indian Ocean that the remains of Pithecanthropus were discovered. And it was in Java that the most ape-like of human beings, the now extinct Negrito tribe of Kalangs, dwelt until quite recently.

Most anthropologists are of opinion that it was somewhere in the extensive regions of Southern or South-Central Asia that the great stride from the humanoid to the human status was attained, and man, as such, first evolved in Pliocene times. The climatic conditions of these regions in Middle and Late Tertiary times are believed to have afforded special stimuli to bring about such evolution. Dr. Keane along with Manouvrier, Klaatsch and others hold that "Java was one of the first regions reached by primitive man and his miocene precursor during their eastward migrations from the subsiding Indo-African continent".³ Geologists however tell us that the separation of the Indian Peninsula from Madagascar and Africa occurred in early Tertiary times. And, indeed for the purposes of a South-Asiatic cradleland for Proto-man, it is hardly necessary to float this long-submerged mesozoic continent. The Indo-Malaysian regions were perhaps sufficiently extensive and suitable to be the centre of evolution and despersion of our Proto-human ancestors. But I

³ *Ethnology* (1901), p. 262.

need hardly tell you that every such theory is nothing more than an inference which may any day be displaced by some fresh discovery elsewhere of human or simian remains. Such discoveries have been heralded by officers of the Indian Geological Survey,⁴ but not yet actually made, among the Siwalik foot-hills of the Himalayas. And it is not unreasonable to expect that some day India may be definitely proved to have been the original home of man.

In fact, expert opinion is not yet unanimous on this question of the cradle-land of humanity ; for, besides Indo-Malaysia, we find Central and South Central Asia, India proper, Burma, Syria, Africa or Eurafica, Australia, Scandinavia and some other parts of the globe including even the Arctic regions and America, where no fossils of the family Simiidae have yet been found, having each had its advocates among eminent scientific men. Among these the arguments in favour of a Central Asian cradle-land advocated by Quatrefages,⁵ Arlt and others, and those in favour of an area extending much further to the north and east advanced by Wallace may be noticed.

Thus, in support of a Central Asian home it has been suggested that this area is extensive enough for the divergent evolution of the several human species ; that it occupies a central position for migrations to other lands ; that it is not far from Java where the earliest known human remains have been found ; that the three fundamental types of all the human races are represented in the populations grouped round this region ; that the three fundamental types of human language—monosyllabic, agglutinative and inflexional—are found in the same countries under similar relations ; that it was the seat of the most ancient civilizations of the world, and the area where most of man's domestic animals and many of the domestic plants were finally evolved ; and that the climatic conditions of these regions in Miocene and early Pliocene times were such as would compel our pre-human ancestors to leave the trees for the simple reason that the trees left them.

Wallace, as I have said, would extend the cradle-land further to the east and north-east. And his arguments in favour of this theory of the probable birthplace of man may be quoted in his own words.

⁴ As early as in 1857, Blandford suggested that relics found on the Nerbudda and Godavari valleys indicated the presence of Man in India long before the appearance of man in Europe, *Journal of the Asiatic Society of Bengal*, 1857, pp. 144-145.

⁵ Quatrefages, *The Human Species* (1881), pp. 175-176. In his *Introduction to the Study of the Human Race*, pp. 133-134, Quatrefages put forward a "boreal theory" of the origin of man in the Arctic regions under the semi-tropical conditions of the Tertiary Period, and his gradual dispersion southward before the increasing cold.

Says he,⁶ "It has usually been considered that the ancestral form of man originated in the tropics where vegetation is most abundant and the climate most equable." But there are some important objections to this view. The anthropoid apes, as well as most of the monkey tribe, are essentially arboreal in their structure, whereas the great distinctive character of man is his special adaptation to terrestrial locomotion. We can hardly suppose, therefore, that he originated in a forest region, where fruits, to be obtained by climbing, are the chief vegetable food. It is more probable that he began his existence on the open plains or high plateaux of the temperate or sub-tropical zone where the seeds of indigenous cereals, and numerous herbivores, rodents, and game-birds, with fishes and molluscs in the lakes, rivers, and seas supplied him with an abundance of varied food. In such a region he would develop skill as a hunter, trapper, or fisherman, and later as a herdsman and cultivator, a succession of which we find indications in the palæolithic and neolithic races of Europe.

"In seeking to determine the particular areas in which his earliest traces are likely to be found, we are restricted to some portion of the Eastern hemisphere, where alone the anthropoid apes exist, or have apparently ever existed.

"There is good reason to believe, also, that Africa must be excluded, because it is known to have been separated from the northern continent in early Tertiary times; and to have acquired its existing fauna of the higher mammalia by a later union with that continent after the separation from it of Madagascar, an island which has preserved for us a sample, as it were, of the early African mammalian fauna, from which not only the anthropoid apes, but all the higher quadrumana are absent. (See Wallace's *Geographical Distribution of Animals*, Vol. I., p. 285.)

"There remains only the great Euro-Asiatic continent; and its enormous plateaux, extending from Persia right across Tibet and Siberia to Manchuria, afford an area, some part or other of which probably offered suitable conditions, in late Miocene or early Pliocene times, for the development of ancestral man.

"It is in this area that we still find that type of mankind the Mongolian—which retains a colour of the skin midway between the black or brown-black of the negro and the ruddy or olive white of the Caucasian types, a colour which still prevails over all Northern Asia, over the American continents, and over much of Polynesia. From this primary tint arose, under the influence of varied conditions, and probably in correlation with

⁶ *Darwinism* (Macmillan, 1912), pp. 459-460.

constitutional changes adapted to peculiar climates, the varied tints which still exist among mankind. If the reasoning by which this conclusion is reached be sound—and all the earlier stages of man's development from an animal form occurred in the area now indicated—we can better understand how it is that we have as yet met with no traces of the missing links, or even of man's existence during late Tertiary times, because no part of the world is so entirely unexplored by the geologist as this very region. The area in question is sufficiently extensive and varied to admit of primeval man having attained to a considerable population, and having developed his full human characteristics, both physical and mental, before there was entirely any need for him to migrate beyond its limits. One of his earliest important migrations was probably into Africa, where, spreading westwards, he became modified in colour and hair in correlation with physiological changes adapting him to the climate of the equatorial lowlands. Spreading north-westward into Europe the moist and cool climate led to a modification of an opposite character, and thus may have arisen the three great human types which still exist. Somewhat later, probably, he spread eastward into North-West America and soon scattered himself over the whole continent; and all this may well have occurred in Early or Middle Pliocene times. Thereafter, at very long intervals, successive waves of migration carried him into every part of the habitable world, and by conquest and intermixture led ultimately to that puzzling gradation of types which the ethnologist in vain seeks to unravel.”

The weight of present authoritative opinion, as I have said, appears to incline in favour of Southern or South-Central Asia as the original home of mankind. At any rate, there appear to be good reasons for supposing that man was evolved from an anthropogenic stock somewhere in Asia, whether in the area now covered by Syria and Mesopotamia or further south either in India or in the Malay Peninsula or Java, or rather somewhere in the now severed ‘Indo-Malaysian continent’ which then comprised India and Malayasia and almost adjoined the Austral continent.

In endorsing this inference regarding a single cradle-land, at any rate, for the ancestors of *Homo sapiens* or the modern type of man, we accept provisionally, some sort of a monogenetic position. I say ‘provisionally’, because the last word on the subject cannot be said until more facts are forthcoming. According to the monogenetic view, this sudden change in man's nature and status could have occurred *once* only, and that in a single place. And in this sense, man may be said to have sprung from only a single ancestral stock. Whereas the theory of *Monogenism* advocates the common descent of man from a single

**Polygenism
and Monogen-
ism.**

proto-human ancestral stock in a single area, and considers the fundamental varieties to have subsequently evolved in different geographical areas reached by migration from the original cradle-land,—the rival theory called *Polygenism* attributes the origin of the different fundamental varieties of mankind to a number of distinct human species independently evolving in distinct geographical areas. Modern authoritative opinion has generally decided in favour of a modified monogenetic origin of mankind. Thus, in Dr. Keith's ⁷ genealogical tree of man's ancestry the human stem is represented as branching off in late Miocene times from the common 'humanoid' stem (which had separated from the anthropoid stem in the Oligocene), and after throwing off in early or Mid-Pliocene times a few collateral offshoots which produced such forms as the races of *Eoanthropus*, Heidelberg, and Neanderthal, the main stem goes on developing, until at the junction of the Pliocene and Pleistocene ages it evolves into four branches now represented respectively by the African, the Australian, the Mongolian and the European (Caucasian) races. The true picture of the world of ancient man, as now understood, is thus depicted by Keith ⁸ in what might almost sound like polygenist language :—

"We have to conceive an ancient world in which the family of mankind was broken up into narrow groups or genera, each genus being again divided into a number of species—much as we see in the monkey or ape world of to-day. Then out of that great welter of forms, one species became the dominant form, and ultimately the sole surviving one—the species represented by the modern races of mankind." In fact, evidence is fast accumulating to show that the original humanoid stem probably separated into two or three branches of humanity as far back as the Oligocene and that these experiments of nature at length resulted in the higher human type we call *homo sapiens*. But, even among the wide-ranging early Pleistocene (and possibly late Pliocene) ancestral forms whether found in Java in the east, or in England, France, or Germany on the west, a certain correlation is not impossible. ⁹

Having regard to such a modified form of monogenism now generally accepted, the old controversy between Monogenism and Polygenism has now rather a more or less academic interest. The main grounds on which this opinion in favour of Monogeny is founded are, first, what Broca calls *eugenesis* or the complete and permanent fertility of unions between all races *inter se* which would be

⁷ *The Antiquity of Man*, p. 501.

⁸ *Ibid.*, p. 210.

⁹ Keane, *Man Past and Present* (1920), p. 3.

impossible on the Polygenist assumption; and, secondly, the prevailing physical and mental uniformity of all peoples pointing to the specific unity of modern mankind. The first of these grounds at least proves that the differences of race are not specific. The second ground has been questioned and indeed requires for its establishment further advance in our knowledge of the psychology of primitive peoples studied by experimental methods. One main argument advanced in favour of the Polygenist theory is that, as there are so many families of languages in the world which cannot all be reduced to a single original stock, there must have been a number of distinct original human stocks corresponding to them. This argument from the plurality of irreducible forms of speech to the plurality of original human stocks is obviously fallacious and untenable. Race and language are not convertible terms. Anthropological investigation has settled beyond all dispute that language is no test of race. By adapting the words of Professor Rhys we may say, "Skulls are harder than consonants, and races lurk behind, when languages multiply".

Another stock argument against the monogenist theory is the apparent difficulty in explaining how the primary races which have remained comparatively fixed in type all through the historic period, could have acquired such marked ethnic differences by variations from a common original. Wallace's reply to this objection is that the remotely ancient ancestral human groups being as yet too low in mind to have evolved those arts of maintenance and social ordinances by which man holds his own against environmental influences were in their then wild state much more plastic than now so that natural selection and other causes met with very little resistance in forming the permanent varieties or races of man.¹⁰

In connexion with purely Polygenist theories, may be mentioned the ambitious attempt of the great naturalist Agassiz to divide the entire surface of the globe into eight or rather nine kingdoms or centres of appearance of particular species of vegetable and animal forms—the Polynesian kingdom, the Australian kingdom, the Malay or Indian kingdom, the African kingdom (comprising the whole of Africa with the exception of the Southern portion which he names as Hottentot Fauna), the European kingdom, the Mongolian or Asiatic kingdom, the American kingdom, and the Arctic kingdom,—and to attach a particular human race to every centre of appearance as a local product of that centre. Observed facts of Natural History, however, contradict any such theory.

¹⁰ Wallace, *Contributions to the Theory of Natural Selection*, p. 319.

The doctrine of pure Polygenism is, however, not altogether without its adherents among scientists even at the present day. Among polygenist theories, most of which, at this day, are but more or less modified forms of Polygenism, that of Professor **Klaatsch's intermediate theory.** Klaatsch of Heidelberg deserves a passing notice. Klaatsch has attempted a novel polygenetic solution of the fascinating riddle of the origin of man and his races. His conclusions profess to be based on a variety of morphological and other considerations. According to this theory, the starting point of the phyletic pedigree of man is a race named by him as "Pro-pithecanthropi" or pre-ape-men, who are said to have been the common progenitors of both ape and man. These lived, in the remote past, in the Malaysian continent. In the proportions of their limbs and the character of their teeth, they are said to have resembled human beings and not the anthropoid apes. They were, however, still "pro-anthropi" or pre-men, since their foot was yet grasping-supporting and not a definitely and exclusively supporting organ. In the hairy covering of their skin and some other features they are said to have resembled apes rather than men. From this huge concourse of Pro-pithecanthropi, one branch consisting of the ancestors of the Gibbon as well as of Pithecanthropus or the Javan ape-man, is imagined to have separated off together quite early and to have become somewhat isolated, and this is said to be the reason why both the Gibbon and the Pithecanthropus have some morphological characters in common. Another small stream is also depicted as having branched off early and migrated in a south-easterly direction. These were the ancestors of the now extinct Tasmanians and of the Australian aborigines, who have retained very primitive and peculiar anatomical characteristics. Other branches of this eastern horde are said to have settled in the South Sea Islands. One mighty horde poured away in the direction of Africa, and from them the ancestors of the Negrillos or pygmy negroes diverged very early, and next the ancestors of the true Negroes and of the gorillas and gorilloids branched off from the horde—leaving the remnant to pursue their migrations through generations until they eventually reached Europe across the land-bridge that then connected it with Africa. These latter, it is said, were the ancestors of the Neanderthal race who were accompanied as far as to Europe by such pre-glacial fauna as the *Elephas antiquus* and *Rhinoceros mercki*. The reason why the ancestors of the gorilla and of the Neanderthalers are said to have evolved so far together is that their skeletons have many characteristics in common. Another horde, the ancestor of the Aurignacian race of Pleistocene Europe, migrated northwards in the direction of Asia; and from them one

portion branched off to the north-east and became the ancestors of the orang-outang, while the main horde, ever evolving, continued their tedious way westwards through Asia until at length they arrived in Europe also with the Glacial age. In Europe, the Aurignacians met the Neanderthalers and are said to have forthwith exterminated them. These precursors of the Aurignacians are inferred to have kept company with the ancestors of the orang-outang during part of their migrations, because the skeletons of both possess some morphological peculiarities in common. The chimpanzee is said to have separated off from the original stock very early, and to have retained a large number of primitive characters—particularly in its teeth—and is thus believed to be nearer to the Pro-pithecanthropi and therefore nearer to man in the phylogenetic pedigree. Klaatsch's derivation of Neanderthal man and the African gorilla directly from one and the same common ancestor, and of Aurignacian man and the Asiatic orang-outang from another, is unfortunately not borne out by a comparative study of the anatomical structure of the respective human and simian types in question.

It is interesting to note that Klaatsch's own investigation of the skulls of the aboriginal Australians show that the prominent bridges, low brain cap, chinless lower jaw and other physical peculiarities of *Homo primigenius* or the Neanderthal type of man are met with even among living races, so that *Homo primigenius* may not, after all be a separate species from *Homo sapiens* as Klaatsch like Sewalbe and some others suppose, but may perhaps be only a primitive race or sub-species of the latter.

Klaatsch's theory as to the origin of the human races does not admit of any relationship between the primary races of Man except that they are all regarded as ultimately connected at the root of the common genealogical tree of the *hominidæ* and the *simiidæ*. In this way, Klaatsch seeks to reconcile Polygenism with an ulterior Monogenism.

But the more probable and generally accepted view is, as I have said, that from one generalized Pliocene ancestral proto-human stock, that survived more than one experiment of Nature at producing *Homo sapiens*, the primary divisions of modern mankind diverged, in or about Pleistocene times, along different lines of specialization through isolation in and continuous adaptation to different geographical environments. Their diversities are only quantitative and not sufficiently great to justify us in regarding the varieties of modern mankind as so many different species. The various existing types of man only constitute different races.

As their number increased, our Pliocene ancestors, who up till then probably formed one homogeneous Proto-human group would necessarily migrate in successive waves along the different land-routes then available; and these routes, as geological evidence indicates, have not materially changed since late Pliocene and early Pleistocene times. And here, again, we must bear in mind that the first migratory movements of our rude generalized precursors, before they had developed any cultural appliances beyond the ability to wield a broken branch or sapling, or perhaps to chip or flake primitive stone implements, could not have been prompted by any definite idea. They moved about, as has been well observed, "like other migrating faunas, unconsciously, everywhere following the line of least resistance, advancing or receding, and acting generally on blind impulse".¹¹ Starting from their hypothetical centre of dispersion somewhere in Central or Southern Asia, we may trace Man's handiwork along some at least of his probable migratory routes. The remarkable resemblances of these palæolithic and pre-palæolithic implements in different regions would appear to afford some presumptive evidence in favour of the migration of a definite type of humanity. Thus, rudely chipped stone implements have been discovered in Pliocene deposits in the Pahang district of the Malay Peninsula. As we follow the route¹² to the north we meet with possible industrial vestiges of

Further India and Burma.

these early ancestral groups in Upper Burma and Yunnan. Thus, some chipped flint implements, regarded as eolithic by their discoverer Dr. Fritz Noetling, were found, in 1894, in a conglomerate deposit in the Yenang-young district in association with the fossil remains of animals such as *Rhinoceros perimense* and *Hippotherium antelopinum* belonging either to the Upper Miocene or to the earliest part of the Pliocene age.¹³ And the Report of the Archæological Survey of Burma for 1918-19 records the recent discovery of some stone implements (flat, and rectangular or more or less triangular flakes) from the Myaing Township and Pakokku

¹¹ Keane, *Man Past and Present* (1920), pp. 6-7.

¹² This supposed route of the first human migrations proceeds on the basis of the generally accepted view which makes Malayasia the earliest home of Pliocene man. But it would appear that the route might, with at least equal appearance of probability, be traced from India in all directions. In fact, India with its extensive area stands midway between the present home of the African Negroes and negritos to the west, the Oceanic negroes and negritos to the east, the Mongolians to the north and north-east and the Caucasians to the north-west; and future research may make good India's claim to be the original mother-land of modern humanity, as certain western experts have suggested on apparent probabilities.

¹³ *Records of the Geological Survey of India*, 1894, Vol. XXVII, p. 101; also *Natural Science*, Vol. X. (1897), p. 80.

district said to belong to the close of the Pliocene or the beginning of the Pleistocene age.

Passing eastwards into India, although no undoubted palæolithic implements are yet reported to have been discovered in Assam, Mr. S. E. Peal in a paper published in the Journal of the Asiatic Society of Bengal in 1896 noticed the suggestive similarity of certain iron implements now used by the Nāgās of North-Eastern Assam with "the shoulder-headed celts found in the Malay Peninsula and Chōtā-Nāgpur."¹⁴ These shoulder-headed celts are, however, neolithic and therefore of little help to the present enquiry. Lieutenant-Colonel Gurdon notes that the name for the similar shoulder-headed iron hoe of the Khasis is *mo-khiew* which exactly corresponds to the Burmese name for stone celts, which is *mo-gyo*.¹⁵ But this doubtful Assam evidence may well be left out of consideration. Further to the south and west, however, genuine palæolithic implements have been discovered in the Rānchi and Singhbhum districts of Chōtā Nāgpur and you may see some specimens of these in the Patna Museum together with a fairly large collection of neoliths from those districts as well as from the neighbouring district of the Santāl Parganās. Although the names "palæolith" and "neolith" may not have the same chronological setting for different peoples and cultures, and all palæoliths are not equally indicative of prehistoric antiquity but require detailed consideration of the type, and particularly corroborative evidence from geology and palæontology,—from what I have seen and found in different parts of Chōtā Nāgpur, I have reasons to expect that the valleys of the Subarnarekhā and its tributaries in the Rānchi district and of the Sanjai and the Binjai rivers in the Singhbhum district, will, if properly explored, prove as much classic ground for students of prehistoric archæology as the valleys of the Somme and the Vézère in France have proved. Further to the west from Chōtā Nāgpur palæolithic implements have been discovered in the Central Provinces, in the Central India Agency and Rājputānā, and also on the Subarmati in Guzerat; and further to the South they have been discovered in Pleistocene beds and drift gravels in several places in the valleys of the Nerbudda (*Narmadā*) and the Godāvāri, and the districts of Kurnool, Guntur, Nellore, Cuddapah, Chingleput and North Arcot in the Madras Presidency. Some of these Indian implements would appear to resemble in form the Chellian and even Pre-Chellian specimens of Europe where stages of culture have been more carefully studied

¹⁴ Probably the Santal Parganas and not Chota Nagpur is meant.

¹⁵ *The Khasis* (2nd Edition), pp. 10-11.

in connexion with river terraces, ancient caves, loams and loess, and their geologic age determined from fossil plants and animals associated with them. In India, only in two authentic instances palæoliths have been discovered in direct association with the fossil bones of extinct animals. These are the well-known Bhuttra boucher (ovoid quartzite celt) with a sharp edge all round found *in situ* in the ossiferous gravels of the Nerbudda valley by Hackett, in 1873, in the Narsinghpur district, and the worked agate flake found, in 1861, by Wynne from the bone-bearing gravels of the upper Godavari valley at village Mungi in the Hyderabad State. Dr. Falkner referred Wynne's flake to the Pliocene age. And the gravels of the Nerbudda valley in which some of the Indian palæoliths have been discovered are said to have probably commenced some four lakhs (400,000) of years ago. The first recorded Indian palæolith was discovered by Bruce-Foote in 1863 (30th May) at Pallavaram south of Madras. Unfortunately for want of systematic search no fossil human remains have yet been discovered in association with Indian palæoliths or indeed with any Asiatic or African find of palæoliths. The only doubtful human bone was found by Bruce-Foote in Attrampakkam nullah, a small affluent of the Cortelian, a stream falling into the Bay of Bengal eleven miles north of Madras, in association with a large number of palæoliths. As the bone had lost both articulations, its identification with part of a human tibia with the platynemic deformation found in people given to squatting on the ground, cannot be free from doubt.¹⁶ [See also note at p. 118 *post.*]

¹⁶ Vide *Journal of the Geological Society of London*, Vol. XXX; *Proceedings of the Asiatic Society of Bengal*, 1865, p. 201; *Records of the Geological Survey of India*, 1873, p. 49; Coggin Brown's *Prehistoric Antiquities of the Indian Museum*, p. 2; and Bruce-Foote's *Indian Prehistoric and Proto-historic Antiquities*, pp. 4-9; *Journal of the Bihar and Orissa Research Society*, Vol. II, p. 61, and Vol. III, page 349. The materials of which the majority of early Indian palæoliths are made appears to be quartzite. Logan (*Old Chipped Stones of India*) is disposed to think that "the quartzite men entered India from the north-west and after their first settlements in Rajputana and the rest of North India, turned southward by way of Orissa, always following the quartzite ranges till they arrived at Madras whence they sent out branches West and South." "It is quite possible," he adds, "that little hairy brown men, the ancestors of Bhils, Khonds, and other unimprovable races of modern India were then hunting in woods with clubs and pebbles, and were either exterminated when their room was wanted or left alone where there were no suitable stones to tempt invasion." The reasons suggested by Logan for the supposed European origin of the ancient Quartzite men of India—namely, the absence of any traces of the 'prentice hand' as evidenced in Europe by eoliths, the essential identity in form of Indian and European palæoliths, the use of hard quartzite and not a more tractable material suitable for the 'prentice hand',—may however be otherwise explained. The greater prevalence of quartzite in India, the absence of systematic search for Indian eoliths and indeed of palæoliths and other industrial vestiges of early man in India, the possibility of the invention of the common forms of eoliths and palæoliths before the different branches of *Homo sapiens* left their original centres, may be among possible explanations.

Leaving India and proceeding further west, we find palæoliths in the Lebanon in Syria. Although here **Arabia, Syria and Africa.** implements only of the Mousterian type have hitherto been discovered, when we go further west to Africa we find in ancient river deposits, in Western Algeria, in the Congo basin and in Somaliland, palæoliths exhibiting a gradual transition from Pre-chellian and Chellian through Acheulian and Mousterian and late Palæolithic types right on into implements of the Neolithic type, just as we find them more or less in the Nerbudda valley and in Chōṭā Nāgpur in India.

Here I may note, in passing, that M. de Mortillet first divided **Stages of Palæolithic Culture.** Palæolithic culture in Europe into four stages as Chellian, Mousterian, Solutrian, and Magdalenian, named after the places where most typical specimens of the different types were found. Breuil and his colleagues discovered in the Spanish cave of Castillo, ten archæological strata, superimposed one upon the other, proceeding from the Mousterian (two levels) to the Neolithic by way of the Aurignacian (three levels), the Solutrian, the Magdalenian (two levels) and the Azilian. Not long ago M. Cumment has by his stratigraphy for the valley of the Somme established the existence of a pre-Chellian culture to which Sollas has given the name of Strepyan from Strepy in Belgium. At present the seriation of Pleistocene cultural stages proceeds from the Eoliths and Rostro-carinates or Crag Implements of the First Glacial and Inter-glacial phases through the Strepyan, Chellian, Acheulian and Mousterian stages of Mid-Glacial times, successively to the Aurignacian, Solutrian, Magdalenian and Azilian cultures of late Palæolithic times. The Azilian culture forms the transition stage between Palæolithic and Neolithic cultures. The later phase of Azilian industry is known as the Tardenoisian and is remarkable for the manufacture of fine pygmy geometric flints besides flat barbed harpoons. As I have said, it has to be remembered that these cultural stages may not have the same chronological setting for different peoples and different countries.

Chellian and Strepyan implements are found in Europe in **First Immigration into Europe.** Mindel-Riss Inter-glacial deposits, and opinion is divided as to whether Man's first appearance in Europe occurred in the Günz-Mindel or first Inter-glacial phase or in the next Mindel-Riss Inter-glacial. Certain supposed European eoliths are said to reach back to the Pliocene and even earlier times. If their human origin is finally established, the time and place of man's origin may have to be reconsidered. In the island of Capri, which once formed

part of the mainland of Italy, as many as forty coup-de-poings besides scrapers, borers, and other palæoliths have been discovered in what appear to be Mindel-Riss Inter-glacial deposits; and even rougher and ruder types of palæoliths have been discovered in the high terraces of the Tevere and its tributaries near Perugia. Similar implements have been discovered near the Zambesi Falls in Africa, and it has been reasonably inferred from the available archaeological and palæontological evidence, that the earliest human inhabitants of Europe along with elephants, rhinoceroses and hippopotami and other African and Indian animals migrated from Africa most probably across the land-bridge that then connected Tunis with Sicily and Italy, and that some of these Chellian inhabitants held on to Europe through the rigours of the Riss Glacial phase, and in process of time became the Acheulians and the Mousterians.

During the warmer part of the Riss-Würm or third Inter-glacial phase, across the same Tunis-Sicily route, **Second Immigration into Europe.** a fresh wave of migration of men and animals from Africa appears to have brought into Europe the Aurignacians and their companions of the short Negroid type represented by the skeletons discovered by Dr. Verneau in the Grottes de Enfants at Grimaldi in France.¹⁷ Thus the older theory held by Kramberger and others that there existed in Europe but one early race which successively evolved into the Mousterian, Solutrian, and Magdalenian stages of culture has been modified by the more reasonable theory recently advanced by M. L'Abbe Breuil and fairly well supported by palæontological, morphological and archaeological evidence. Breuil suggests that the Aurignacians of African affinities thus arriving probably by way of Tunis, Sicily and Italy found the Mousterian or Neanderthal Man in France, and that these new-comers lived on in Europe through the Würm Ice Age and became in course of time the Magdalenian or Cromagnon Race. The discovery in 1901 by Kramberger in a cave at Krapina (Hungary) of the fractured bones of both races lying side by side lends colour to the view held by Klaatsch and some others that the Aurignacians exterminated the Neanderthals after bloody fights. It is held by some authorities that the Aurignacians who were in a higher grade of evolution, absorbed the Neanderthals, and this first known racial intermixture, one of the most important agents in evolution,

¹⁷ The Grimaldi remains appear to have been those of an adult female and a boy. The boy was buried in a more or less contracted position with his right arm round the woman's femur. The bones are said to have been slender and graceful. The nose was broad and sunk at the root. The cranial capacity of the woman was 79.27 and of the boy 68.58 and their stature 1540 and 1580 mm. respectively. The jaws are markedly prognathic and the chin not well developed. In their teeth they are said to closely resemble the modern Australians.

is responsible for the Cromagnon race, remarkable for their improved stature, their reindeer-hunting and their fine carvings and tools in bone and ivory and the famous cave paintings in the rock shelters of, among other places, *La Madeline*. This place, as we have seen, gave its name to this last phase of Pleistocene culture in Europe as Magdalenian.¹⁸ As to how the Cromagnards with their powerful and well-shaped bodies, large brains and high artistic skill, became extinct and were supplanted by newer types of man in Europe, we have no means of knowing.

There are industrial and skeletal vestiges of still another migration into Europe. And this time it was not from Africa but from Asia. The handiwork of these Solutrians, as they have been called from their typical station of Solutre, in France, their beautiful flint spearheads of "laurel-leaf" and "willow-leaf" patterns—said to be the finest examples of artistic stone-work ever fashioned by man—are scattered abundantly in East Central Europe in the later Riss-Würm and earlier Würm age deposits.

Palæontological evidence shows that during the Solutrian and Magdalenian culture-periods the climate in Europe changed; the mammoth, the woolly rhinoceros, the cave-bear, the cave-lion and the cave-hyena disappeared giving place to the reindeer as the characteristic animal in Europe during the closing phases of the Pleistocene period. From the fact that not a single implement of the Solutrian type occurs in the Mediterranean regions and the further fact that the Solutrians appear to have entered Europe along with the Steppe animals, such as the wild ass or "horse of Prjevalsky," and the Saiga antelope, and again left Europe and followed the migrations of the reindeer eastward as soon as steppe conditions disappeared,—from these facts it has been inferred that they were the first eastern invaders of Europe. No skeletal remains can yet be attributed to them with any certainty, unless we consider the brachycephalous skulls of Furfooz, Offnet, Grenelle and La Truchere

¹⁸ The remains of Magdalenian hunters have been discovered from Italy through France and Spain to Belgium and England, and through East Central Europe and Russia to Siberia. As I have already noticed, in certain cave shelters in India, particularly in the Mirzapur district in the United Provinces and at Singanpur in the Central Provinces, spirited drawings generally of hunting scenes bearing some resemblance to prehistoric drawings in European caves have been discovered. And the Billa Surgam caves of the Yerrakonda hills in the Karnul district of the Madras Presidency have yielded a number of bone implements, unbarbed as well as barbed, which appear to resemble those found in Magdalenian caves in Europe. But the Magdalenian phase of culture in India may not improbably have been chronologically anterior to the same phase in Europe. It may be mentioned that in the Karnul caves the fossil remains of an extinct Primate named *Presbytis* (*Semnopithecus*) *entellus* (?) have been discovered in what appears to be a Pleistocene horizon. The Edakkal cave drawings in the Bellary district have been supposed to be of a neolithic date.

to represent the type.¹⁹ With the first round-headed Furfooz race who came to Europe from the direction of the Danube we reach the immediate forerunners of Neolithic man. In the Azilian-Tardenoisian age, which dates after the close of the Magdalenian culture period, we find in Europe, new types of man,—the long-headed, short-statured, rather dark "Mediterranean race," the short-headed, sallow-skinned "Alpine race," slightly taller than the former, and the tall, long-headed, fair-skinned "Nordic race," established in the parts of Europe that they still occupy.²⁰ But these do not concern us in the present lecture.

It would be an extremely interesting study to trace the gradual development of early man's skill in fashioning these stone implements, from the doubtful eoliths, with their three subdivisions—Reutelian, Mafflian and Mesvinian, hardly distinguishable from certain natural stones, and the more genuine-looking Crag implements or Rostro-carinates, slightly compressed at the sides and curved at one end in the shape of an eagle's beak, on through the gradually improving forms of the almond-shaped Strepyan hand-wedges, the lozenge-shaped Chellian implements, and the pointed Acheulian implements to the nicely flaked javelin heads of "laurel-leaf" and "willow-leaf" patterns of the Solutrian age. I would fain have dwelt at some length on this fascinating topic and attempted to correlate, so far as possible, the Indian specimens with their European analogues were it not beyond the scope of the present lecture to do so.

To go back to our Proto-Man. We followed him from his hypothetical Asiatic home through Burma and India into Africa and thence into Europe. We also saw another wave of migration from Central Asia reaching Europe much later in company with steppe animals. This was probably an offshoot from the main branch of our proto-human ancestral stock that entered what is now the Tibetan Plateau and in course of time differen-

¹⁹The kitchen middens of the Tagus valley in Portugal have yielded human bones representing about 200 individuals, mostly women and children and a large number of bone and stone implements which Breuil assigns to the Tardenoisian period. Some of the skeletons found at Mugem are characterized by brachycephaly. Professor A. Mendes Corrêa in a paper on the Origins of the Portuguese in the *American Journal of Physical Anthropology* (April—June, 1919) says that Mugem and the Azilian station at Offnet (Bavaria) "constitute the most ancient definitely ascertained paleo-ethnological deposits in which brachycephaly appears in the European *Homo sapiens*." Vide also *Man* (February 1920), p. 31.

²⁰The Nordics are generally believed by experts to be a variety of the Mediterranean race. Dr. Haddon suggests that the Nordics and the Mediterranean race "may equally well be two varieties of a common stock, the 'Proto-Nordics' having probably their area of characterization in the steppes north of the plateaus of Eur-Asia, and migrating eastwards and westwards as the country dried after the last glacial phase." Vide *The Wanderings of Peoples* (1911).

tiated and specialized as the Mongolian stock. If the Indo-Malaysian continent be provisionally taken to have been the original home, this Proto-Mongolian branch would probably have proceeded either by way of Burma or through India. Geologists tell us that up till late Pliocene times, the Central Asian plateau was much more easy of access from India than at the present day. In the absence of adequate palæontological and archæological explorations, however, the secrets of osseous or industrial remains of early man in Tibet and other regions in northern Asia still remain hidden beneath the earth.

In America, where a subdivision of this Central Asiatic branch appears to have made their way across the frozen Behring strait probably in Pleistocene times, the perseverance of prehistoric archæologists and anthropologists have unearthed numerous artifacts of the Stone Age; palæolithic implements have been discovered in the State of Kansas under deposits of the phase of maximum glaciation. The palæoliths discovered by Dr. A. C. Abbott in 1875 at Trenton in the valley of the Delaware river, and the remains of the men who fashioned those implements, have been now proved to belong to the Pleistocene period. For, the Trenton gravels in which they were found embedded are deposits of the Ice Age. Although fossils of such *anthropoidea* (of the family *cibidæ*) as *Homunculus patagonicus* have been discovered in American Eocene deposits, and there is evidence to indicate that North America was probably the birthplace of the first primates, no reliable evidence is yet forthcoming to show the existence of man in the New World before the Ice Age, and anthropologists are generally agreed that man must have migrated to the New World from the Old.²¹ And from the discovery in Argentina and Brazil of ancient skulls of the short as well as of the long type, some anthropologists infer that there was a double migration into America, one of a broad-headed Mongolian stock by way of Behring strait and another of a long-headed European stock by way of Greenland.

Whether the 'Indo-Malaysian continent' formed the original cradle-land of man, or whether proto-man proceeded thither in his early migrations from further north and west, we may picture to

²¹ It may be noted that such an eminent authority as Sergi places the cradle-land of mankind in South America and believes that the first human migrations occurred by way of the Antarctic continent of Australia and thence through the South Sea Islands to Asia and Europe. But there appears to be no reliable evidence to support this theory. As already noticed, Dr. Ameghino now claims to have discovered a fragment of a human jaw with two molars along with a stone fireplace of the Tertiary age, and the bone is said to indicate a type of man far older than the oldest hitherto discovered. Ancient stone implements and other artifacts had been previously discovered in and about the site (ravines of Chapalmal and Miramar) where the new finds were secured.

ourselves how when this continent broke up and became further removed from the Austral continent the particular ancestral group that had already passed into the Austral continent and became the Australian and Tasmanian aborigines, would have been cut off from the rest of the proto-human stock. This would seem to have happened perhaps before the ancestors of the Proto-Mongol branch migrated to north-eastern Asia and in course of time developed into the Yellow race, and the ancestors of the Proto-Caucasian branch left the hypothetical cradle-land for west-central Asia which may probably have been the area of characterization and centre of radiation of the modern White or Caucasian race. According to Stratz, the aboriginal Australians are the nearest to the common monogenetic original form; the next to be separated and differentiated were the Papuans, Koikoin, and kindred races, on the one hand, and the black races of Africa on the other; the third group to be separated from the ancestral stock of mankind were the Mongolian races, the Malays of the interior of the Peninsula, the Kanakas, the Andamanese and the American Indians; after the main Yellow race had been thrown off from the main stock, there was formed the fourth proto-morphic group comprising such tribes as the Ainu of Japan, the Vedda of Ceylon, the Dravidians of India, the Basques and the Celts; and, finally, the main White race was developed. In the opinion of Sir Harry Johnston, the Proto-Negro probably originated in India and after throwing off branches to the eastward bent its main migration through Arabia to Africa, and after perhaps having permeated the whole Mediterranean basin prior to the evolution of the Caucasian race, had to retreat to the south of the Great Desert, where for untold centuries the type has "vegetated without any infiltration of a different or a superior race, and in a condition of culture as low as that of the Neanderthaloid Australians."²²

In this way certain proto-human hordes isolated in the widely separated tropical regions extending from Africa south of the present Sahara as far to the south-east as Australia, in some way or other, developed a dark skin colour, curly or woolly hair, and other distinctive physical characteristics, and so became in time the Proto-Negro. Another horde, after long segregation in the high plateaux of Northern Asia, developed a yellow colour, straight hair, broader or shorter skull and a vertical fold of skin over the inner canthus of the eyes, and other distinctive racial features, and thus became the Proto-Mongol. While a third horde passing through India, Western Asia and Northern Africa into the cold temperate climate of Europe evolved either in Europe, or more probably in

²² *The Living Races of Mankind* (Hutchinson & Co., London), Vol. I, p. 354.

west Central Asia, the fair skin, wavy hair, and those distinctive physical and mental characters which are now recognized as the hall-mark of the Caucasian race. At a comparatively early stage of the evolution of the races, the Proto-Mongol horde, as we have seen, appears to have thrown off a branch in the direction of America which subsequently evolved into the so-called Red Indian race.

In characterizing some racial features as "low", anthropologists do not mean to imply that any one race is superior in all respects to any other race or races. Biological observation does not warrant any such assumption. As Dr. Franz Boas²³ observes, "It must be strongly emphasized that the races which we are accustomed to call the higher races do not by any means stand at the end of the series and are farthest removed from the animal. The European and the Mongol have the largest brains; the European has a small face and a higher nose—all features farther removed from the probable animal ancestor of man than the corresponding features of other races. On the other hand, the European shares lower characteristics with the Australian, both retaining in the strongest degree the hairiness of the animal ancestor, while the specifically human development of the red lip is developed most markedly in the negro. The proportions of the limbs of the negro are also more markedly distinct from the corresponding proportions in the higher apes than are those of the European. When we interpret the data in the light of modern biological concepts, we may say that the specifically human features appear with varying intensity in various races, and that the divergence from the animal ancestor has developed in varying directions." Perhaps by reason of their arrested development certain peoples, however, would seem to take us back somewhat nearer to our Pleistocene Proto-human ancestors. Among the Tasmanians and Australians and among the Negro pygmies, more than among any other sections of mankind, we meet with traces of many primitive characteristics, in physique, mentality and culture. The Tasmanians and the Australians²⁴ who are, on the whole, said to furnish "the examples of the greatest concentration of ape-like characters," have never advanced beyond a primitive Stone Age Culture. And either these or probably the Negro pygmies, who with their relatively long-head (from one-sixth to one-seventh of the total stature), small brain, with forehead rounded in the middle giving an infantile appearance to the face,

²³ *The Mind of Primitive Man*, 1916, p. 22.

²⁴ There are reasons to believe that the earliest inhabitants of Australia were Negritos who were subsequently cut off from the mainland and formed the ancestors of the Tasmanians. The present Australian Blacks are considered to be a blend of the remnant of the original Negritos with a "pre-Dravidian" people who are said to have later overrun the continent.

with excessive prognathism, broad cheek-bones, flat, broad nose, very wide nostrils, a retreating chin and protuberant stomach, with the curvature of the spine less marked than in ordinary races, and with feet adapted for grasping and climbing as well as for walking, would appear to be the least developed type of man, may be supposed to make the nearest approach to Proto-Man.

The earliest Proto-human ancestors of *Homo sapiens*, as we have seen reasons to infer, probably emerged from a previous pre-human or humanoid stage in Middle or Late Pliocene times, somewhere in the warm climate of South Central Asia—either in India, or Burma or Malaysia. Africa and Australia as well as the other continents were in those days much easier of access by land-routes from the supposed Indo-Malaysian cradle-land. Up to early Pleistocene times, India remained connected with Malaysia on the one hand and Ceylon on the other, and this 'Indo-Malaysian continent' maintained land-connexion at various points with the other continents. Even at the commencement of the Palæolithic culture age in Europe, a traveller starting, as Sollas²⁵ says, "from the banks of the Thames could have made his way over the watershed formed by the straits of Dover into France, and so through Italy and across Sicily into Africa, which would have then lain open from end to end. If, instead of entering Africa he had turned to the left, he could have reached India by devious paths; the Malay peninsula united here and there by land-connexion would have taken him with the help of a frail canoe into Australia whence he might have wandered into Tasmania." Thus then all the evidence hitherto available would appear to indicate that true Man originated somewhere in South Central Asia in Pliocene times, and his descendants gradually peopled the whole earth by Pleistocene and Post-Pleistocene ages.²⁶

²⁵ *Ancient Hunters*, p. 113.

²⁶ Two old human crania from India were recently examined by Dr. A. Keith. One was found in 1910 by Mr. Wolff in the alluvial deposit 35 feet below the level of the bed of the Gambhir river near village Bayana (U. P.), during an excavation for a railway bridge. Dr. Keith found this cranium to belong to Risley's 'Aryo-Dravidian' racial type. Dr. Vrendenburg opines that if, as the perfectly smooth surface of the skull indicates, it lay embedded in the fine-grained silt of the nature of "loess" so abundant in the Bayana region, the formation in which it was found would be one of the early Pleistocene age. In Europe, however, all the fossil human remains of that period belong to the Neanderthal race. As for the Sialkot remains found in the watershed of the Indus (Punjab) by Lt. Hingston, in 1912, on the side of a deep nullah six feet below the level of the adjoining field, clear indications of a burial were present. The dimensions and form of the Sialkot skull are considered by Dr. Keith to indicate a greater predominance of the Aryan characters. Both these crania "belong to the type abundantly represented in the districts in which they were found". "Their value lies in the fact that they may yet serve as evidence of the persistency of type." *Journal of the Anthropological Society of Bombay* (1920), p. 663, seq.

LECTURE VI.

Evolution of the Human Races and their Classification.

In the fifth lecture we have seen reasons for accepting the doctrine of the specific unity of modern mankind and to hold that the various existing human types constitute only different races or sub-species and not so many distinct species. As they form correlated members of the species *Homo sapiens*, their differences are only quantitative. And the anthropologist classifies these distinctive physical characteristics into groups to represent his basic types or races of man. In the beginning, as we may reasonably infer from our knowledge of the normal course of organic evolution, the Pliocene ancestral groups formed one homogeneous whole differing but little from one another though possessing a tendency to variability. As naturalists tell us, "species is the point of departure; the *variety* appears among the individuals of which it is composed, and when the characters of this variety become hereditary a race is formed."¹ The process by which *Homo sapiens* became gradually differentiated into different sub-species or races must have been similar to that by which the human stem itself specialized and evolved from the common ancestral anthropoid stock.

In this work of race-differentiation, environment has been the chief modifying agent and heredity the preserving agent. In the words of Duckworth,² "The factors which have determined the evolution of the various modern human types may be summed up under the comprehensive, but somewhat vague term, 'environment'. Of these influences one of the most potent is geographical situation, with its attendant advantageous or disadvantageous relations to temperature and food-supply, and with indirect effects on habits and temperament. By the latter, the action of such secondary factors as sexual, physiological, and other modes of selection, must be profoundly influenced. By such conditions the path of morphological evolution has been determined in the past, and in the future it will be modified by similar influences, masked though they may be in the more civilized of the Hominidæ."

¹ Quatrefages, *Human Species* (2nd edition, 1881), p. 39.

² *Morphology and Anthropology* (1904), p. 545.

As for the characteristics of our generalized Pliocene ancestor, anthropologists infer that he was a tropical or sub-tropical furry animal with russet brown hair and a blackish or perhaps a yellowish brown colour. The skin-colour of the anthropoid apes indicates a common ancestral stock with brown pigmented skin. The skin of the Australian aborigines who have preserved so many other primitive features has a lighter black pigmentation than that of the typical Negro. The Bushman subdivision of the Negroes—one of the most primitive groups of mankind—still retain a yellowish colour. Among certain other Negritic tribes, too, a tendency to revert to the yellow colour has been observed. On the other hand, no branch of the yellow or Mongol variety of mankind has been known to show a tendency to assume a dark skin-colour. These facts combined with the further phenomenon that children of African and Australian parents exhibit, immediately after birth, a yellowish-brown colour in their skin which assumes a dark tint at a later age, appear to support the inference that the blackness of the Negro skin is a character subsequently acquired by long isolation in a tropical climate—and that the skin-colour of the generalized Proto-Man, the common ancestor of the black, the yellow, and the white races was a blackish or yellowish brown.

Experts tell us that colouration of the skin is the conjoint effect of a number of environmental factors working through physiological processes. The epidermal cells seem to produce pigment and the influence of light appears to favour the formation of black pigment. The characteristic skin-colour of the different races appears to have been very slowly acquired through the influence of environment and other causes and has now become fixed through heredity. The differences of different races in the colour of their skin, hair and eyes are explained as the result of different factors, internal or organic, such as the chemical action of glandular secretions which Starling has named 'hormones', and certain extra-organic factors such as light, temperature, humidity, as also diet and occupation which depend on climatic, geographical, and social conditions. Any particular shade of colour is said to depend on the amount and seat of a kind of brownish pigment. The eye looks blue or blue-grey when the pigment has its seat only in the black layers of the iris which appear blue through the cloudy outer layers of tissue. When the other layers of the iris contain the pigment, the eye-colour varies from light to dark-brown. The pigment of the skin is found chiefly in the epidermis. The peculiar blue, grey or black natal spots in the sacro-lumbar region known as the Mongolian spots which appear in new-born children (and disappear within two to five years after birth) mostly of the Mongolians but also of many coloured races and

occasionally of white races, is produced by pigment in the corium or true skin. In a cold climate where thermal action is weak, a decolouration of pigment in the skin and other parts of the body produces a kind of albinism. Although in the race-forming period, environment powerfully affects pigmentation of the skin, hair, and eyes,—the colour-characters, after they have once become fixed, appear to remain fairly stable even with a change of habitat.

It is in northern climes, in Germany and Scandinavia which enjoy no more than from 1,250 to 1,500 hours of sunshine in the year, that we first meet with white skin, blue eyes, and blonde hair. The Teutonic races whose descent is traced by many authorities partly to the Neanderthal race, must in consequence have lived since mid-Pleistocene times in a climate not favourable to the production of a dark pigment. The Lapp and the Eskimo, on the other hand, though living in the Arctic Circle remain exposed to almost continuous sunlight for half the year, and may have thus acquired a dark skin-colour. Among the so-called white or Caucasian race, we find not only the actual xanthochroid (or white) European, but also the melanochroid (or dark) Aryan Hindu, Semitic Arab and Hamitic Berber. All such facts appear to point to the effects of light and heat on the range of human colour-type in relation to latitude. As for the yellow colour of the Mongolian skin, although this is generally attributed to extreme temperature conditions and a dry atmosphere, most experts hesitate to give any definite opinion because of their inadequate knowledge of the early history of the Yellow race.

Professor L. W. Lyde, in a paper on the *Climatic Control of Skin Colour*, read before the Universal Races Congress of 1911, however, says:—"The Yellow man is essentially the product of desiccation of grass-lands in the temperate latitudes. Here the fundamental conditions are lack of humidity and seasonal extremes of the temperature. Again, the absence of cloud makes light the dangerous element, and the man must be pigmented, but the question of temperature is also important. The natural colour is, therefore, one which conserves heat nearly as well as white, but which also protects from light; and in these latitudes a colour from the low end of the spectrum gives ample protection, especially as the minimum cloudiness is associated with the winter season: that is to say, on the great steppes and prairies of the Northern Hemisphere as upon the great plateaux and tundra, the normal colour should be some shade of yellow or red". In the absence of any knowledge of the early history of the race, the so-called copper colour of the American Indians who really exhibit various shades of yellow colouring varying, as Denniker says, from "dark-brownish yellow to pale olive-yellow", can only be

vaguely referred to some unknown factor or factors in their physical environment in the particular part of America which formed the original area of their specialization. When they spread over the whole of America, the climatic conditions apparently favoured the preservation of the coppery skin colour. Lyde asserts that a definite scheme of colour zones may be formulated by relating temperature as conditioned by sunshine and relief, to rainfall as implying humidity and cloudiness. The climatic influence that has produced the fundamental differences of skin-colour between the black and the white types of man is thus explained as purely due to climatic influence working both directly from without and indirectly through the different relative activities of lungs and intestines. "The tropical climate throws on the skin and the intestines the work which the temperate climate throws on the lungs. The consequent increased activity of the lungs, in the presence of relatively little sunlight and sunheat, favours the lighter colour of skin, while the increased activity of the liver and other intestines, in the presence of relatively great sunlight and sunheat favours the darker colour." Under these circumstances, as Lyde says, "Whatever the value or worthlessness of skin-colour is as a test of 'race', it is enormously the most important consideration in the climatic distribution of man". Thus, then, the different colours of yellow, black and white that now differentiate the three or four main divisions of mankind would appear to have been subsequently acquired to a great extent, if not primarily, through long isolation in their respective new homes in different climate-zones exposed to different degrees of intensity of sunlight, which helped either in increasing or decreasing the degree of pigmentation.³

The shape of the head,—the general proportions of its length, breadth and height,—is regarded as one of the tests of race. Not that a broad-head denotes deficiency in intellect or civilization, for the Shape of the Head and the Face. Caucasoid race who now stand in the vanguard of civilization share the same dolichocephalic head-form with the most backward races on the earth such as some of the Negro and Negrito tribes of Africa and Oceania and such miserable black tribes as the Australians, the Sakais and the Veddas. But it is said that the head-form is more stable and persistent than any other anthropometric characteristic, and, as such, is a reliable criterion to distinguish races. Dr. Walcher, however, has, from experiments with the head of a number of twins found, that lying on the back or on soft pillows tends to produce brachycephaly,

³ Recent researches tend to show the importance of the chemical action of the thyroid gland upon the skin. The supra-renal glands in the abdomen also appear to affect skin-colour.

while lying on the side or on hard pillows tends to produce dolichocephaly.⁴

There is, indeed, a widespread practice among several peoples in India and other countries to seek to artificially mould the head to a desired shape during infancy.⁵ Westermarck seeks to show that such deformative practice tends to exaggerate the characteristics peculiar to a people.⁶ Thus, the practice of artificially flattening the occiput is met with among some of the naturally brachycephalic aborigines of Asia and America, whereas some of the African Negro tribes are found to artificially exaggerate their natural long-headedness. We have probably to refer this tendency to what Giddings terms the "consciousness of kind". As soon as this consciousness is evolved and the social group comes to recognize the possession of certain physical traits peculiar to itself, it sedulously attempts to give the fullest expression to that ideal.

From an observation of emigrants from various European countries living in the City of New York and their development, Dr. Boas concludes that there is good evidence to show that the various European types undergo certain changes in a new environment. "The investigation of a large number of families", he writes, "has shown that every single measurement that has been studied has one value among individuals born in Europe, another one among individuals of the same families born in America. Thus, among East European Jews, the head of the European-born is shorter than the head of the American-born. It is wider among the European-born than among the American-born. At the same time the American-born is taller. As a result of the increase in the growth of head and decrease of the width of head, the length-breadth index is considerably less than the corresponding index in the European-born. All these differences seem to increase with the time elapsed between the emigration of the parents and the birth of the child, and are much more marked in the second generation of American-born individuals". It is most remarkable that Dr. Boas found that the change in head-form of American-born individuals occurs almost immediately after the arrival of their parents in America. The child born in America, even if born only a few months after the arrival of the

⁴ For instances of the practice, vide *L'Anthropologie*, Vol. IV, pp. 11—27. But Dr. Boas observes that the difference of head-form in large areas of Europe, in which infants are treated in the same manner, are too great to make this explanation acceptable.—*The Mind of Primitive Man*, p. 50.

⁵ *Report of the Census of India, 1911*, Vol. I, Part I, pp. 382-384, and *Journal of the Bihar and Orissa Research Society*, Vol. I, pp. 27—30.

⁶ *History of Human Marriage* (third edition), pp. 283-284.

parents, has the head-form of the American-born. Like head-form, the stature of European-born individuals has been found to increase the more, the younger they were at the time of their arrival in America. The width of the face decreases the more, the younger the child came to America. These facts would go to show a decided plasticity of human types. But, as Dr. Boas says, "the structural changes which accompany the modifications of gross form are entirely unknown, and the physiological functions which are affected by the new environment cannot even be surmised". Much more extensive investigations are needed to understand the correlation between bodily form and function and outward influences. But one thing appears to follow from Dr. Boas' investigations: as he himself observes, "the old idea of absolute stability of human types must evidently be given up, and with it the belief in the hereditary superiority of certain types over others". It would be as unwarrantable to say that man has progressed from dolichocephaly to brachycephaly as the opposite suggestion made by Dr. Myres that, "it is possible that the Neanderthaloid and Australian type, or, perhaps, long-headedness in general is only a temporary diversion, due to special conditions, of a primitive brachycephalic type". Although the skull of anthropoid apes, particularly of the orang-outang, is short, wide and flat, the skull of *Pithecanthropus* is long though peculiarly flattened from crown to base in the manner of anthropoid skulls, and the skulls of the Neanderthal and Cromagnon types are also long. The probable inference, therefore, appears to be that Proto-Man was long-headed. According to Dr. Keith, the evolution of the form of the human skull seems to have taken place in the following order: "The anthropoid skull, short, wide, flat, seems to be the oldest form. In the early human stock it became long, moderately wide, and flattened; later, it became long, narrow, and high, and, lastly, short, wide, and high".⁷

There appears to be better justification for calling the great projection of the upper jaw, known as **Facial angle**, "prognathism", a "low" feature. For the evolution of the almost vertical position of the Caucasian and Mongolian face from the extreme projection of the anthropoid apes and of Proto-Man appears to have been brought about not so much through climatic changes as through change of occupation and habits of life. The change from a prognathous to an orthognathous face appears to have a close connexion with the

⁷ *The Human Body*, p. 172. Besides the form of the cranium, the volume of its capacity in individuals of different races is measured and compared. Ridgeway however, opines that "it may eventually be proved that just as each race has its own type of colouration, so also it has its own osteological character". If this is established, head-form, like skin-colour, will cease to be regarded as a reliable criterion of race.

change from raw to cooked food and modified dentition. Cuvier's "facial angle" which determines the various degrees of gnathism or projection of the upper jaw, is, therefore, generally accepted as an important test of race. The facial angle indicates the angle made by the whole face with the brain-cap. It may perhaps be inferred with reasonable certainty that Proto-Man was markedly prognathous.

An obvious criterion of race is the nature of the hair of the head and body which is but a horny product of the skin. The principal varieties of hair are straight or leiotrichous as among most Yellow or Mongolian peoples, wavy or cymotrichous as among the White or Caucasian race, and woolly or ulotrichous as among most Bushmen, Negroes and Melanesians. Thus, skin-colour would appear to be somehow correlated with the nature of the hair. Another type called frizzy, is distinguished as intermediate between the wavy—with its variant (curly) hair—and the woolly hair.

On a microscopic examination, the transverse section of the hair appears circular or cylindrical in the straight hair, a lengthened ellipse in the woolly hair, and a less extended ellipse in the wavy hair. In the frizzy variety the hair is rolled spirally, and in the curly variety the hair is rolled up at the extremity. Three principal shades of hair-colour are distinguishable, namely, black, brown and fair. Brown is divided into dark-brown and chestnut-brown. Proto-Man, it is inferred, possessed more or less straight dark hair.

The correlation between the nature of the hair and its absolute and relative length is a point worth noting. Straight-haired races such as the Chinese and the American Indians are found to possess the longest hair, woolly-haired races the shortest, and wavy-haired races hair of medium length. Further, whereas in the straight-haired races both men and women have equally long hair, and in the woolly-haired races both sexes have equally short hair,—among the wavy-haired as well as some frizzy-haired races there appears a marked difference between the two sexes in their length of hair. The beard, which is a sexual characteristic of man, also appears to be clearly correlated with the hair of the body. The more abundant the body-hair of any people, the thicker generally is the beard.

Next, as for the shape of the nose, the nose of Proto-Man presumably resembled the short, broad, flat or snub and platyrrhine nose of the Negrito; and, new-born infants, it is interesting to note, exhibit similar

nasal characteristics. Although it has been suggested that the peculiar aquiline nose of Aymara and Quechua Indians of Peru is a consequence of the rarefied air of the plateau, experts do not attribute the modification of nose to atmospheric conditions, and hardly any scientific explanation has yet been authoritatively offered. Yet from the earliest times the shape of the nose, like the colour of the skin, has been regarded as a means of race discrimination. In the *Rig-Veda*⁸ the indigenous dark tribes of India are described as "anāsa"⁹ or "noseless", and "visipra" or "with deformed noses". The structure of the face, as Topinard observes, influences the nasal bones. And the close association of a tall stature with a narrow nose has been taken by some anthropologists to point to a law. But, as we have seen, change of environment, social as well as geographical, influences, to some extent, the form and stature of the body and also perhaps the development of the nervous system. The investigations of Bolk have shown that an increase in stature has occurred in Europe during recent decades, which is evidently due to change of environment.

The average height of a people and, in a lesser degree, the proportions of the different parts of the body
Stature. form noticeable features differentiating different races of men. The different races of men are found to vary in stature from an average of four feet four inches to an average of five feet ten inches. Although stature, it must be admitted, is a very variable characteristic, individual variations in all races are governed by the same laws and cannot exceed certain limits imposed by race. Leaving out of account certain chance individual variations which may be said to be freaks of Nature, the differences in the average height of the different races and sub-races appear to be the resultant of a number of factors, chief among which are environment, particularly as affecting food-supply, natural selection and artificial selection due to occupation and habits of life. It is a matter of common ethnological observation that inadequacy and uncertainty of food-supply as well as sedentary habits of life hinder growth and stunt the stature, and a plentiful food-supply increases it. Thus, the people of mountainous districts are found to be of a lower average stature than those living on fertile plains and river-basins. The presence of lime in the water has also been said to tend to increase the stature. Thus, the Mediterranean regions are deficient in limestone and this may be in part responsible for the shorter stature of the Mediterranean race. Differences in stature between rural and urban populations have also been noticed. Fresh air and exercise too appear to influence stature and growth.

⁸ *Rig-Veda*, XXIX, 10.

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⁹ *Ibid*, XLV, 6.

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Over and above the direct influence of environment, we have to take account of the factors of natural as well as artificial selection. As an instance of natural selection with reference to stature, it has been pointed out that "while the populations at moderate altitudes seem to be physically depressed by their surroundings, those from regions of the greatest elevation seem to be rather above the normal stature". Ranke suggests the explanation that only those of decided vigour are able to withstand the rigours and privations in this latter case, leaving an abnormally tall, selected population as a result. The anthropometric data hitherto collected on this point are, however, too limited to justify any generalization. The operation of artificial selection in varying the stature within certain limits, may be exemplified by the differences in stature seen in persons following different occupations and professions. Statistics taken in Switzerland between the years 1884 and 1889 show that while among professional men 47 per cent. and among ecclesiastics 45 per cent. are men of 5 feet 7 inches (170 cms.) or upwards, only 7 per cent. amongst tailors, 11 per cent. among factory operatives, cobblers, and spinners and weavers, and 12 per cent. among chimney-sweepers and basket-weavers, attain that stature; and while only 2 per cent. among professional men and 4 per cent. among ecclesiastics are under 5 feet 1.4 inches (156 cms.) in height, the percentage of men below that stature among tailors is 33, among factory operatives 24, among cobblers 20, among spinners and weavers 21, and among basket-weavers 23. Again, city life and early marriage appear to lower the stature. Thus, the Polish Jews who marry at the age of fourteen to fifteen are the shortest people in Europe. The Cromagnon race appear to have attained a higher stature than their Aurignacian forbears, as the Aurignacians in their turn were taller than the Neanderthal, and the only explanation that has been offered is that the strenuous conditions of life in and after the Ice Age somehow operated in increasing their stature. Proto-Man was presumably not remarkable for his stature.

Anthropometric observations tend to indicate that, on the whole, the advance from savagery to barbarism and from barbarism to civilization may have some connexion with a progressive increase in stature. In fact, it is mostly in the misery spots of the earth that we meet with the shortest men. Thus, environment would appear to be an important factor in the original variations of stature as of pigmentation, and artificial selection has also its share in contributing to the result. And these two factors, aided by others whose nature is not yet known, modified the stature of the primary human groups in course of time.

The fact that adult men are, as a rule, four or five inches taller than adult women of the same race appears to point to

the influence of the sexual organs on stature. Experts are now generally agreed that the genital glands throw into the circulation a secretion which has an important influence on the nutrition, growth and general well-being of the body. There are, again, reasons to infer that one of the factors influencing growth is the secretion of the pituitary gland which lies at the base of the skull under the brain, and that any alteration of the secretion of the gland acts upon the epiphyseal lines or the growing lines of the bones and stimulates them. It is to this perhaps that we have to refer the enormously increased growth of the bones that produces the condition known as giantism as exemplified by such specimens as "O'Brien, the Irish giant", whose skeleton, preserved in the Hunterian Museum in London measures 2,358 ms. or 7 feet $8\frac{2}{5}$ inches. The opposite phenomenon exemplified by the nine-year-old "Sicilian Dwarf", Caroline Crachame, whose skeleton, preserved in the same Museum, measures only 20 inches in height, has perhaps to be attributed to a deficiency of secretion from the pituitary gland and also perhaps from the thyroid. Stature cannot, however, be taken as a general criterion of race, although in certain cases it is a good test as, for instance, to distinguish the tall Patagonian with a mean height of five feet ten inches from the stunted Bushman with a mean height of four feet six inches.

Among other morphological differentiae of the human races may be mentioned the relation of the bones of the upper to those of the lower limbs, the relation of the maximum breadth and height of the pelvis, the degree of curvature of the vertebral column, and even the musculature and the general formation and dimensions of the soft parts, as for instance of the face, the breasts of women, and the genital organs. In this connexion, steatopygia, or the excessive projection of the buttocks due to the accumulation of subcutaneous fat, characteristic of the Bushman race, as also the "apron" or excessive development of the *labia minora* among Bushman females may be noticed. Such tests as the contour of the face (such as oval, pentagonal, lozenge-shaped and so forth) and the proportions of the limbs in their relation to the trunk are found to be uncertain and unsatisfactory. Thus, although primitive races have, generally speaking, a short trunk and long arms and legs and civilized peoples have generally a long trunk and short arms and legs, the differences are not found to be greater than those between members of different sections in one and the same people. The comparative study of all these minor anatomical characters and of such physiological characters as the processes of respiration, circulation of the blood, reproduction including menstruation and menopause, of such pathological characters as liability to or immunity from certain

diseases or the peculiar odour recognizable in some peoples particularly in certain primitive tribes, such as the true Negro, of certain psychological characters such as temperament, and customary attitudes and movements of the body expressive of the temperament, expression of the emotions, as also of the relative sensory acuity,—or, in other words, sensitiveness to touch, taste, smell, colour and sound—motor power, strength, speed, power of endurance and other psycho-physiological characters either directly measurable by reaction-times, or roughly estimated by observation of their greater or less intensity among different races, is still in its infancy. But physiological factors and the influence of the hormones or the secretions of the ductless glands on the physiological differences between races are now being recognized as more important than the anatomical characters. Another remarkable modern development of the study of animals,—and particularly of man,—is the recognition that each order, family, genus and species has a definite chemical personality at the back of the complex morphological and psychological characters that go to form our ordinary concept of it. These chemical personalities, though not detected by our unaided senses, are evidently recognized by various animal parasites and insects, and are revealed to us by the precipitation reactions by which medical workers now test the chemical relationship between organisms.

Such are some of the differentiae that the proto-human ancestral groups—the proto-Negro, the proto-Mongol, and the proto-Caucasian—gradually acquired through special adaptation to the different habitats in which they became long segregated.

Besides their special physical characters, each of these primary groups segregated in different climatic zones, would naturally acquire, in course of time, distinctive linguistic, sociological and other characters—modes of speech, and of food-quest, habitation, clothing and the like. The internal and external conditions to which they were exposed in their respective new habitats disturbed the equilibrium of the organism, and to restore the disturbed equilibrium the unit-characters necessarily altered by analytic or synthetic change, either through minute fluctuations—a little more of this and a little less of that,—or through the formation of novel patterns, perhaps qualitatively rather than quantitatively new. Through such disturbances and re-adjustments, the primary races appear to have been evolved, and through a similar process, new sub-races have since been evolved and may be evolved in future. And, in this way, arose the secondary races and from them arose other sub-races. Biologists tell us that certain peculiarities marking a variety or race are associated with certain peculiarities in the number, size, and perhaps other qualities of the chromosomes within the nucleus of the fertilized egg-cell and its descendant

cells, and that germinal changes sometimes occur in response to subtle environmental and nutritive stimuli which affect the germ-plasm.¹⁰

In designating the main existing racial types as primary, it is not implied that they "go back in purity to the first differentiation of the human species". All that is meant is that they represent the main racial types finally fixed after various experimental stages in which the physical differentia would probably have been combined in every conceivable way. To this day, in the Black division of mankind, generally characterized by long heads, the Mincopis of the Andaman islands, the Negritos of the Philippine islands, and the Negrillos of the Congo basin, although black and woolly-haired like the rest, possess broad or narrow heads. In fact, there is hardly a single living people at this day who can claim to be anthropologically a pure race.¹¹ This racial miscegenation, when made under favourable circumstances, has produced types superior in fertility, virility, and cultural possibilities. Thus, Dr. Boas' investigations among the North American Indians have shown that half-breeds are taller than pure bloods, half-breed children grow faster than pure-blooded ones, and half-breed women are more fertile than those of pure blood. It is with reference to such intermixtures that Duessman said, "No people without a trace of foreign blood can institute a culture". When, however, the blending has been between races of greatly divergent and unequal cultures, the effect has been disastrous. Mr. D. R. Bhandarkar in his paper on *Foreign Elements in the Hindu Population*¹² has adduced some epigraphic evidence to show that there is hardly a class or caste in India which has not a foreign strain in it, and that there is an admixture of alien blood not only amongst the Rajputs and Marathas but even amongst the Brāhmins. Anthropological data about modern Indian races, although as yet extremely meagre for want of workers, would also appear to point to the same conclusion. And ample corroborative evidence to the same effect may apparently be gleaned by diligent search among ancient Sanskrit literature.

¹⁰ The number of chromosomes in each human being is said to be something like 25 trillions. The number of chromosomes in the cells of a White Man is said to be 47 and that for a White Woman 48, whereas the number in the cells of a Negro is 22 and in a Negress sometimes 24.

¹¹ Dr. Keith maintains that the Jews and the Lapps are the only two pure races in Europe. Vide *Nationality and Place* (Oxford University Press, 1919). It must be noted however that the influence of miscegenation in the formation of new races appears to be limited. As Ridgeway observes, "Even from the evidence already to hand there is high probability that intermarriage can do very little to form a new race unless the parents on both sides are of races evolved in similar environments."

¹² *Indian Antiquary*, Vol. XL, p. 736.

Neither the selective action of the environment, nor sudden mutations due to immigration or miscegenation, singly or in conjunction, can, however, be taken as sufficient in themselves for racial differentiation. How imperfect is the present state of our knowledge of the operations of the different human organs and of other external and internal causes in affecting the origin and development of racial types, may be understood from what Dr. A. B. Keith in his presidential address at the last annual meeting of the Anthropological section of the British Association declared as to the all-important part played in the differentiation of the primary racial types by certain organs of the human body hitherto considered unimportant. Dr. Keith asserted that the ordinarily accepted view of the process of differentiation of the human races is altogether inadequate to explain the evolution. "The evolutionary machine as it is commonly understood", said he, "does not supply a clue to the origin of the European, the Chinaman, and the Negro. But nature has at her command a secret mechanism by which she works out the new patterns in the bodies of man and beast, a mechanism of which we were almost ignorant in Darwin's day, but which we are now beginning to perceive and to understand dimly.

"There are five small glands which in recent times have come to be recognized as parts of the machinery which regulate the growth of the body. They form a mere fraction of the total weight of the body, not more than 1-180th of it. These are the pituitary body, about the size of a ripe cherry, attached to the base of the brain and cradled in a pit of the skull; the pineal gland, also attached to the brain and little larger than a grain of wheat; the more bulky thyroid, set astride the windpipe in the neck; the two supra-renal bodies attached to the kidneys; the interstitial glands embedded in the substance of the male and female genital glands. The growth of the body may be accelerated, retarded, or completely altered if one or more of these glands become the seat of a functional disorder. Alterations in the relative importance of these glands may well be the cause of the qualities that differentiate the three racial types of man."

Although several biologists, chemists and medical men in Europe and America have been engaged for over a quarter of a century in studying the functions of the thyroid gland, its chemical action in the human organism is just beginning to be surmised. In 1913-14, Dr. Child of Chicago claimed that by an administration of preparations from the thyroid glands of sheep he could normalise deficient growth and increase normal growth in children and animals. In 1915, Dr. Chambers of New York opined that idiocy, hysteria,

crime and genius depended on the deficiency or superabundance of the thyroid gland. And recently, Mr. Julian Huxley of Oxford has positively asserted that the thyroid gland, among its other functions, regulates metabolism or the various chemical processes that underlie and form the necessary foundations of life and growth,—that deficiency of this gland produces sluggishness in mind and body and even dwarfishness and imbecility, whereas excess of it produces excitability and loss of flesh. Dr. Keith is of opinion that the influence of the thyroid is specially concerned in the differentiation of the Mongolian race: it acts directly on the skin and the hair, and it is further due to the action of this gland that the root of the nose appears to be flattened and drawn backward between the eyes, the upper forehead projecting and bulging, the face flattened, and the bony scaffolding of the nose, particularly when compared with the prominence of the jaws, greatly reduced. These facial characteristics gives the Mongolian face its characteristic aspect, and to a lesser degree may also be traced in the features of the Negro.

As for the Caucasian race, Dr. Keith is of opinion that the pituitary body was specially concerned in its differentiation. Should further investigation corroborate these views, anthropological research will have to break new ground; and fresh lines of enquiry thus opened may revolutionize the science.¹³

Whatever be the mechanism by which Nature worked out in her own laboratory the different primary patterns in the original uniform type of the bodies of our proto-human ancestors, certain it is that groups of them diverged in varying directions into different types after long isolation in different climatic zones. Broadly speaking, these primary patterns which survived the experimental stages may be said to have been three or four in number.

From the three or four fundamental varieties or races formed and fixed by long isolation, there were evolved, in course of thousands of years, later variations and sub-races through fresh migrations, local isolation, miscegenation, Mendelian segregation, and other causes, known and unknown. And thus the present number of these sub-races is legion. And one prime task of the anthropologist has been to classify these numerous subdivisions of mankind according to their biological and ethnical affinities.

Having thus obtained some idea as to the nature and origin of the complex of physical characters which mark off one racial

¹³ Important investigations are being carried out by the Medical Research Committee in England on the functions of the pituitary body which would appear to have even a greater influence on our growth than the thyroid gland. Evidence is accumulating to show that it is the most important factor in determining not only stature, but also cast of features, texture of skin, and character of hair.

type from another, we shall now proceed to inquire as to the methods by which the anthropologist distinguishes different races and sub-races and classifies them according to biological or other relations.

Of the three classes of tests, namely, physical, cultural and linguistic, that might be applied for purposes of race-discrimination, the physical tests are now unanimously accepted as the most reliable. For, language which may be easily borrowed by one people from another can be evidence mainly of racial contact. Even such fundamental linguistic characters as intonation and accent systems, the primary vowel and consonant systems, the primary suffix and affix systems, and the primary vocabulary may be influenced by contact-metamorphosis as also perhaps by the convergent action of similar physical and social environment. Dr. Franz Boas has adduced good reasons for holding that "the present types of man are older than the present linguistic families, and that each type developed a number of languages".¹⁴

Culture, like language, may also be borrowed by one people from another, or modified by contact and convergence. And with regard to culture, over and above the convergent action of similar environment—physical, social, and economic—we cannot altogether ignore the much-criticized "law of unfolding stages of development", according to which different races would tend to exhibit a similar pattern of culture at the same or similar stage of evolution.

It is, therefore, the relatively constant physical characteristics of different peoples that the anthropologist takes as the basis of his classification of the human races and sub-races. Not that these provide an infallible test, for recent researches would appear to indicate that even anatomical and physiological characters tend to converge, within certain limits, towards a common pattern in the same or similar environment; and different offshoots of the same race may under new environmental conditions diverge from the radicle and converge towards other ethnical patterns. On the whole, however, the physical tests afford a more satisfactory basis of classification than cultural including linguistic characteristics, although these may often be of use as corroborative evidence.

¹⁴ In *The Mind of Primitive Man*, Ch. V., Dr. Franz Boas cites instances to show that "at least at the present time, anatomical type, language and culture have not necessarily the same fates; that a people may remain constant in type and language and change in culture; that it may remain constant in type but change in culture; that it may remain constant in type but change in language; or that it may remain constant in language, and change in type and culture".

Precise methods of measurement are now employed by anthropologists to obtain reliable data for comparing various dimensions of skulls and other parts of the human body as a basis of race-classification. And to ensure uniformity among all workers in the field and to co-ordinate their systems of measurements, among other attempts, the German anthropologists formulated, in 1882, a standard scheme known as the Frankfort Agreement, and the Anthropometric Committee of the British Association, which commenced its work in 1902, published, in 1908, its final report fixing a standard method of anthropometric investigation.¹⁵

It is recognized, however, that neither absolute nor relative measurements sufficiently bring out the distinguishing physical peculiarities of different races. Thus, in the Indian Census Report for 1911, Sir Edward Gait writes: "It may be noted here that many anthropologists are no longer satisfied with mere arithmetical indices, which fail to bring out the peculiarities in shape, such as the flatness of the back of the head mentioned by Thurston as so common in Madras, and that much more importance is now attached to contours. Sergi, for example, classifies skulls according to their general shape as ellipsoid, cuneiform, ovoid, etc., and ignores altogether Topinard's cerebral index, or ratio of breadth to length on which stress has been laid in Indian anthropometry".¹⁶ Sergi's revolt against all anthropometric methods including craniometry which he describes as "a kind of kabala which will prove anything and everything",¹⁷ is not, however, shared by the majority of anthropologists. The Italian anthropologist's method of cranial forms is not generally considered to be an adequate and satisfactory substitute for the more orthodox numerical methods; anthropologists in general still continue to employ what Sergi supposes to be "the old and discredited method of the cephalic index" invented by Retzius, in preference to Sergi's own system of classification of skulls as *pentagonoides acutus*, *ellipsoides cuneatus*, *sphenoides latus*, and so forth. The general form of the skull (oval, ellipsoid, etc.) and the contour of the face (more or less angular or rounded), have, however, their value in the differentiation of the races and cannot be altogether ignored. An useful method to supplement the orthodox anthropometric method is that of making outline drawings or projections and comparing forms thus obtained—a method which has been employed by the German anthropologist Klaatsch to construct triangles (cranio-trigonometry) and to define curves as segments of circles (cyclography of

¹⁵ Vide Report of the British Association (Dublin), 1908, pp. 351ff.

¹⁶ Census Report, India, Vol. I, 1911, p. 382.

¹⁷ The Mediterranean Race, pp. 106-7.

the skull). This method of outline drawings has the advantage that all possible dimensions and angles can be subsequently measured independently of the subject. To obtain as correct an idea as possible of the peculiar physical characteristics of different races and sub-races, the anthropometric method might be usefully supplemented by the graphic method and the descriptive method of noting their morphological peculiarities. But psychometry bids fair to eclipse anthropometry in the near future.

The main physical characters which anthropologists at present generally accept as more or less satisfactory for race-discrimination are, as we have seen, the colour of the skin, hair and eyes; the form of the hair; head-form; the conformation of the face; the shape of the nose; and, to some extent, stature.

By a comparative investigation of the variations in respect of each of these characters exhibited by different human groups and sub-groups, the anthropologist seeks to establish numerically the differences between them in the most exact manner possible. The greatest possible number of individuals of any group or sub-group is observed and, when possible, measured, and the results recorded, and the mean of the results is taken to express the particular racial character.

By a comparative investigation of skin-colour, we find that the three primary divisions of mankind, popularly known as the White, the Yellow, and the Black races, really exhibit a variety of shades of colour intermediate between the three ideal types. In the White Division, we find the reddish-white skin of the northern and eastern European; the dull-white of the western European; the clear-brown of the Afghan and the Aryan Hindu; and tawny-white of the Semite, the Berber, and the Mediterranean peoples of southern Europe and northern Africa, and the Assyroids,—as Denniker designates certain Kurdish tribes,—some Armenians, and Jews, and the Hadjemi Persians. Denniker's classification of the Todas of the Nilgiri Hills among these tawny-white Assyroids might, however, seem to be open to objection.

In the Yellow division, we get the yellowish-white skin of the Lapp, the Ugrain and the Turkish; the pale-yellow of the Northern and Southern Mongol, the warm yellow or sallow skin of the Patagonian and of the native Indians of Northern and Central America; the tawny-yellow of the Polynesian and the Indonesian; the coppery-yellow of South American tribes; and the brownish-yellow of the Eskimo.

In the Black division, we find included besides the pure black of the Bantu Negro and Nigritian, the reddish-brown of the

Negrito and the Negrillo, the chocolate-brown of the Australian native, and brownish-black of the Melanesian, the Australian, the Sakai of the Malay Peninsula and Sumatra, the Toala of Celebes, and, doubtfully, the Dravidians of India, and such pre-Dravidian tribes as the Veddas of Ceylon, the Kurumbas and Irulas of the Nilgiri Hills, and certain other jungle tribes of India.

Although in the same individual the colour of the eyes, hair, and skin may be different, the colour of the hair and eyes is generally correlated with skin-colour. Thus, in Northern Europe, we find white skin along with fair hair and blue or grey eyes, and in the Mediterranean regions brown skin along with brown or brownish black hair and eyes.

In investigating colour, the anthropologist examines, where possible, parts of the body not habitually exposed to the air. The different shades of hair colour are noted in good light but not in direct sunshine, and marked differences, if any, in the colour of the hair of the head from that of the beard or the body are noted. To express the results of his observation with scientific precision, eyes are classified, according to the colour of the iris, into dark, including all shades of brown and black; blue including all shades; light, including light grey, bluish grey, and lightest green; and neutral comprising very light hazel, yellow, most shades of green, dark-grey, hazel-grey, brownish-grey, and all uncertain colours. The hair is classified, according to colour, into 'fair' comprising yellow, whitish-yellow, flaxen and golden, ash blonde, lightest brown and pale auburn; 'brown' comprising light-brown and dark-brown; 'black' comprising jet black and darkest brown; and 'red' comprising light-red and dark-red. To indicate the variations of colour, anthropologists use chromatic tables in which specimens of the main variations of colour are marked by numbers. Broca distinguished as many as thirty-four shades of colour, but the shades I have mentioned are the ones recommended in 1908 by the Anthropometric Committee of the British Association. Blue eyes, flaxen hair, and white skin constitute the blonde type; brown eyes, brown hair, and dark skin are characteristics of the brunette type.

As the form of the hair is found to be a more useful test of race than colour, some anthropologists have made it the basis of race-classification.¹⁸ The races of the world have been broadly classified on this basis as the wavy-haired white race, the straight-haired yellow race, and the frizzly or woolly-haired black race. Besides the Caucasian race with hair varying from the smooth to wavy and even curly form, we find the Indonesians, the Polynes-

**Race
classification
by Hair-form.**

¹⁸ Vide Appendix II.

sians, the Ainus, certain American tribes such as the Botocudos, and the Pre-Dravidians such as the Veddas, the Sakai, the Todas, the Australian blacks, some jungle tribes in India such as the Kadirs, the Kurumbas and the Irulas, and the various tribes and castes now classed together as the Dravidians of India, generally described as wavy-haired. The hair of some of these tribes of India, as also that of the Australians, might be more appropriately referred to the frizzy type which is intermediate between the wavy or cymotrichous and woolly or leiotrichous types. I have met more than one Oraon with a distinctly woolly hair, and the occasional occurrence of woolly hair has also been reported about some South Indian Dravidians. The hair of the Hamites or white Ethiopians too are described by some anthropologists as frizzy. The "mop" or "tuft" of the Papuan and Hottentot hair is a variety of the woolly hair. The Bushmen, the Negro, the Negrillo and the Melanesian races represent the pure woolly-haired type. The hair of the Indonesians, the Finns and the so-called Turco-Tartars would really appear to be generally lightly-waved, often inclining to be straight, and these peoples have accordingly been classed by Denniker, according to hair-character, as intermediate between the wavy and straight-haired types.

Travellers' tales about "hairy races" would appear to have no foundation in fact. Such cases as those of the family of "hairy men" from Burma, or "dog men" of Russia do not really represent any "hairy race" but would seem to be instances of atavism,— "a reversion", as Denniker says, "to the probable primordial condition of man or of his precursor at the period when he was as hairy as, for instance, the anthropoid apes of to-day."¹⁹

The shape of the head or skull is regarded by most anthropologists as a constant and persistent racial character; and by a comparative study of the head-forms of different races and sub-races, they are broadly divided into three main classes, as dolichocephalic or long-headed, brachycephalic or broad-headed and mesaticephalic or mesocephalic (medium-headed). In long-heads, the percentage ratio of the breadth of the skull to its length falls below 75; in broad-heads the ratio is 80 and upwards; in medium heads the ratio ranges from 75 to 79·9. The ratio is expressed by what is called the Cephalic Index which is thus = $\frac{\text{Breadth} \times 100}{\text{Length}}$. In accordance with the Frankfort Agreement of 1882, heads with a cephalic index not exceeding 74·9, are now classed as dolichocephalic, those with an index ranging from 75·0 to 79·9 as mesocephalic or mesaticephalic, and those with an index of 80·0 and

¹⁹ *Races of Man*, p. 45.

upwards as brachycephalic. To these names, the International Agreement of 1883 added the following: ultra-dolichocephalic (with a cephalic index of from 55.0 to 59.9), hyper-dolichocephalic (60.0 to 64.9), hyper-brachycephalic (85.0 to 89.9) and ultra-brachycephalic (90.0 to 94.9). French anthropologists call skulls with a cephalic index of 75.01 to 77.77 sub-dolichocephalic and of 80.01 to 83.33 sub-brachycephalic, and restrict the term mesocephalic only to indices from 77.78 to 80.0. In the head of the living, the length-breadth proportion is roughly two units higher than the proportion in the skull of the same subject after death. Generally speaking, the difference between the cephalic index of an average man and that of an average woman of the same race seldom exceeds one unit. Some anthropologists call the index for the skull "cranial index" to distinguish it from that for the head of the living to which alone they would confine the name "cephalic index". By correlating the head-form with the shape of the face, Ripley²⁰ has adopted the working hypothesis, "long head oval face, short head round face". This rule is said to be of great assistance in the identification of racial types. The height of the head which gives an idea of its general form is also, to some extent, a noticeable race-mark. Heads are divided according to height calculated by the length-height index into low or platycephalic or chamaecephalic (with an index up to 70.0), medium or orthocephalic or metriocephalic (from 70.1 to 75.0), and high or hypsicephalic (over 75.0). The Eskimos of Greenland are characterized by hypsicephaly or extreme height of skull. Next to them may be mentioned the Thlinkits of America and then the Samoyads and Mongolian types.

On the basis of the cephalic index, the Teutons or Nordics of Europe, the Mediterraneans of South Europe and North Africa, the Semites, the Hamites, the Aryans of India, the Indonesians, most Polynesians, the Dravidian tribes and "Dravido-Hindu" castes, the "Pre-Dravidians" already enumerated, the Eskimo and, according to Denniker, certain South American Palæo-Amerinds, the Melanesians, the Bushmen, the Hottentots, the Nigritians or Sudanese Negroes, the Nilotic Negroes, most Bantus and the Papuans are all broadly classed as dolichocephals; the Chinese are sub-dolichocephals; the Sakais and the Semangs of the Malay Peninsula and East Sumatra, certain Polynesian tribes, the Aetas (negritos) of the Philippines, the negrillos of the Equatorial forests of Africa, the Ainus of Japan, most Eastern Siberians, including some sections of Ugrians, and the North American Indians are classed as mesati-cephals; and the Alpines inhabiting in and about the plateaux

²⁰ *Races of Europe*, p. 39.

and mountains that extend from the Himalayas through Asia Minor and the Balkan Peninsula to Central France and Brittany, the Armenians and Cevenoles, the Māhrāṭṭās of Western India, the Afghans or Pāṭhans of the Punjab, certain sections of Bengalis, all American Indians and Mongols except those classed above as dolichocephals and mesocephals, the Andamanese, and certain Polynesian tribes in the Tonga, Marquesas and Hawaiian Islands, are all classed as brachycephals. Ordinarily, crania are broadly distinguished as dolichocephalic, mesocephalic and brachycephalic. And so in this classification I have not distinguished the different groups according to the minor subdivisions of cranial types. It may be noted that the measurements of 695 Hindus of Bihār taken by the now defunct Ethnological Survey of India gave a mean cephalic index of 75·7 which is just eight points above the maximum for dolichocephaly. The Bihār Hindu type is therefore to be classed strictly as mesocephalic according to the Frankfort Agreement, and French anthropologists would term it sub-dolichocephalic. But a mean of the measurements of a heterogeneous group of different Hindu castes is of doubtful racial value. The measurements of 100 Kurmis of Chōṭā Nāgpur gave just the same mean, of 100 Dravidian Khārṇwārs gave an index of 75·6 or just one point lower, and of 100 Dravidian Māl Pāhārīs 75·8 or one point higher. Generally speaking, as Welcker's investigations show, crania ranging from dolichocephalic to hyperbrachycephalic are found among the Mediterranean, Malayan, and American races; from mesocephalic to hyperbrachycephalic among the Mongol race, whereas the black races incline to dolichocephaly.

The result of an examination of the table of cephalic indices of 336 series of heads given in Appendix II of his *Races of Man* is thus summarized by the French anthropologist Denniker: "Dolichocephaly (70 to 74·9) is almost exclusively located at Melanesia, in Australia, in India and in Africa. Sub-dolichocephaly (75 to 77·7) diffused in the two extreme regions—north and south of Europe,—forms, in Asia, a zone round India (Indo-China. Anterior Asia, China, Japan, etc.), but is met with only sporadically in other parts of the world, especially in America. Mesocephaly (77·7 to 79·9) is frequent in Europe in the regions bordering on the sub-dolichocephalic countries, as well as in different parts of Asia and America. Sub-brachycephaly (80 to 83·2), much diffused among the Mongolians of Asia and the populations of Eastern Europe, is very rare elsewhere. Lastly, brachycephalic (83·3 to 84·9) and hyper-brachycephalic (85 to 85·9) heads are almost exclusively limited to Western and Central Europe, to some populations of Asia, Turco-Mongols, Irano-Semites and Thai-Malays."²¹ As

²¹ *Races of Man*, pp. 75-6. The figures within brackets have been added by me.

Denniker observes, this distribution of the different cranial forms on the surface of the earth presents a certain regularity.

As regards cranial capacity, the average capacity for the races of Europe is roughly from 1,590 to 1,600 cubic centimetres; that for the Asiatic races appears to be nearly the same; that for the Negro races and Oceanians a little smaller, perhaps from 1,400 to 1,500 cubic centimetres on an average; and that for the Australians, the Bushmen and the Andamanese is still less, from 1,250 to 1,350 cubic centimetres and even beyond, in favour of men. The cranial capacity of woman represents from eighty-five to ninety-five *per cent.* of the cranial capacity of man.²²

According to the difference in the size of the jaws, as we have seen, the lower part of the face may either project forward or have no projection. Such variations in the projection of the upper jaw (gnathism) has been found to be a fairly good criterion of race. For the determination of these variations, Camper first devised the facial angle or the angle made by the profile line with the auriculo-subnasal line or the line from the ear-orifice to the deepest part of the root of the nose. Retzius, the inventor of the cephalic index, first introduced the term orthognathism to signify an almost right facial angle (90°) and prognathy to signify the more acute facial angle. According to the Frankfort Agreement, the facial part of the skull with a facial angle up to 82 is called prognathous; with an angle of 91 and over, hyper-orthognathous. The term mesognathous has been employed as intermediate between orthognathous and prognathous. The facial angle is defined as the angle formed by the line connecting the naso-frontal suture and the point furthest forward on the upper jaw between the central incisors (alveolar point), with the German horizontal plane (which passes through the lowest point of the under edge of the ear-aperture). The gnathic or alveolar index of Flower is obtained by comparison of the basi-alveolar length with the basi-nasal length. Skulls with gnathic index below 98 are orthognathous, from 98 to 103 mesognathous, and above 103 prognathous. Generally speaking, the White race is orthognathous, the Black race excessively prognathous, and the Yellow race mesognathous.

Broca first discovered the importance of the nose as a means of race discrimination. And anthropologists are generally agreed in accepting it as one of the best tests of race. And with regard to the castes and tribes of India, Risley went so far as to lay down as a law that, "the social status of

²² *Races of Man*, p. 56.

the members of a particular group varies in inverse ratio to the mean relative width of their noses".²³ The character of the nose is, indeed, as Topinard ²⁴ says, included in the category of characters "establishing a transition from the man to the ape". For purposes of race-classification, noses are compared by what is called the nasal index or percentage ratio of the maximum breadth of the anterior orifice of the nose or greatest diameter between its wings, to the nasal height or maximum length from the nasion or the most depressed point at the root of the nose to the sub-nasal point. Noses are divided into platyrrhine or broad, mesorrhine or medium, and leptorrhine or narrow. According to the Frankfort Agreement, nostrils up to 47.0 are leptorrhine, from 47.1 to 51.0 mesorrhine, and from 51.1 to 58.0 platyrrhine and over 58.0 hyper-platyrrhine. The percentage breadth of the nose as compared with the length—that is to say, the nasal index—among the leptorrhinians is under 70, among the mesorrhinians from 70 to 85 and among the platyrrhines above 85. Generally speaking, the nose of the White race is leptorrhine, of the Black race platyrrhine and the Yellow race and the Polynesians mesorrhine. As with other characters, there are exceptions and variations to any such general statement. Among anomalous or hybrid peoples, we find the Pre-Dravidians, the Toalas, and the Australians having platyrrhine or broad noses. Among the Mongols, the nose of the Indo-Chinese appear to be platyrrhine. The Dravidians of India, the Sakais of the Malay peninsula and the Indonesians have mesorrhine noses. The noses of the Ainus, the Anatolians and Cevenoles range between the mesorrhine and platyrrhine, and those of the Bantus of Africa and the Veddas of Ceylon are generally mesorrhine with a tendency to become platyrrhine. The noses of the Polynesians though generally mesorrhine lean towards platyrrhinism. The Koreans, Turks, Ugrians and Finns have leptorrhine or narrow noses. The group of 695 Bibāri Hindus measured by the Ethnological Survey had a mean nasal index of 80.0 and were thus found to be mesorrhine while the group of 100 Kurmis had an index of 82.6.

Stature, though popularly recognized as a criterion of race, is as Risley points out, not a primary character. In conjunction with other characters it is helpful in distinguishing races and sub-races. The average height of man is fixed at 5 feet 6 inches (1,675 millimetres). Races or sub-races averaging over 5 feet 8 inches (1,725 m.) are classed as tall, those below 5 feet 4 inches (1,625 m.) short, and those who fall below 4 feet 11 inches (1,500 m.) are designated as pygmies. In Europe, stature appears to decrease

²³ *The People of India* (1915), p. 29.

²⁴ *Anthropology* (1890), p. 256.

from the north to the south. Thus, the Teutonic race is tall, the Alpine medium, and the Mediterranean race vary from medium to short, and the Turks have medium stature. But although the Norwegian is the tallest European, the Lapps are the smallest. And the Pathans or Afghans and the Sikhs of the Punjab, living in a little lower latitude than the Mediterranean race, are markedly tall, and so also, in lower latitudes, are the Kaffirs of Africa and the Polynesians. The native Australians have a medium stature. But stature can by no means be always correlated with latitude. In Africa we meet with the tallest as well as the shortest sub-races. Thus, whereas the Dinkas of the White Nile have a mean stature of nearly 5 feet 11 inches (or, more accurately, 1,801.6 mm.) and thus rank amongst the tallest races of the world, the Akkas who inhabit the watershed between the Nile and the Congo basins are among the smallest races, if not actually the smallest race in the world, the men measuring 4 feet 6 inches in height and the women 4 feet 2 inches. Further south, we meet with the various pygmy tribes in the Congo forests almost as small as the Akkas, living side by side with the true negroes of average stature. And further south, in Cape Colony, we find the Bushman stock with an average stature of 4 feet 9 inches in the men and 4 feet 7½ inches in the women, and the Hottentots, who are slightly smaller. Dr. Keith, as we have seen, explains this variability of stature characteristic of the negro division of mankind by referring the regulation of stature to the action of certain small ductless glands. When the normal action of these glands is unfixed, small races are produced by under-action and tall races by over-action on the part of the glands. And thus it is that the tallest and shortest races are found in the negro division of mankind.²⁵

In America, the Patagonians are among the tallest peoples in the world and the inhabitants of North America are generally tall. In India, generally speaking, stature diminishes from north-west to south-east and south. In Asia, as a whole, stature may be generally said to decrease in the north in Siberia, and in the south towards the Malacca Islands, and increase in the centre and west particularly as we approach the Himalayas and Turkestan. The group of 695 Bihāri Hindus referred to above had a mean stature of 1,630 millimetres or only five points above the maximum for short stature and therefore near the bottom of the medium scale.

It is evident that for a comparative investigation for purposes of race-discrimination, the anthropologist, as I have said, has to examine and measure the greatest possible number of individuals of any

**Biometrical
method.**

²⁵ A. Keith, *The Human Body*, pp. 66-67.

race or sub-race. An examination of the results of such a study of any race or sub-race, will show that with regard to any given character, the range of variation within each race or sub-race is so great that overlapping of the range of variation in the different groups and sub-groups is a common phenomenon. As the existing races of mankind have descended through millenniums in diverging, converging, and parallel lines from their several Pleistocene ancestral stocks, and the different groups of the present day have a much varied origin, their variability is necessarily very great. So far as individual characters are concerned, it is generally found that the differences between the different types of mankind are, on the whole, small compared to the range of variation within each type. For purposes of a rigorous scientific classification of the various human groups and sub-groups, according to natural affinity, the range, rate, nature, direction and distribution of the variations within any particular group have to be carefully studied, and by eliminating the fluctuations and taking the mean result, the type has to be ascertained. And in this, as in other respects, Physical Anthropology is adopting the most up-to-date rigid scientific methods. The old method of averages which fail to represent the differences of types in a group is being changed by the anthropologist for the biometrical method. The numerical values derived from the study of any group is represented in the form of curves. And with the aid of biometry, the anthropologist now seeks to make a statistical study of variation and heredity, so as to find out the mean of the anthropometric measurements by co-ordination and seriation, and study the extent and frequency of deviations from the mean, by plotting out binomial curves of the indices.

Having in this way collected as extensive series of data as possible regarding the physical characters of the different human groups, Anthropology proceeds to sort them out in classes and sub-classes according to natural or biological affinities. These classes and sub-classes are the "races" and "sub-races" of the anthropologist. Like "species" in Zoology, "race" in Anthropology is, as I have already said, a theoretical conception: races are ideal types or somatological units composed of a particular aggregation of physical characteristics. The anthropologist's conception of "race" and the difference between a "race" and an "ethnic group" is clearly expressed by Denniker as follows:—"On examining attentively the different 'ethnic groups' commonly called 'peoples', 'nations', 'tribes', etc., we ascertain that they are distinguished from each other especially by their language, their mode of life, and their manners; and we ascertain besides that the same traits of physical type are met with in two, three or several groups, sometimes considerably removed the one from

the other in point of habitat. On the other hand, we almost always see in these groups some variations of type so striking that we are led to admit the hypothesis of the formation of such groups by the blending of several distinct somatological units.

"It is to these units that we give the name 'races', using the word in a very broad sense, different from that given to it in zoology and zootechnics. It is a sum-total of somatological characteristics once met with in a real union of individuals, now scattered in fragments of varying proportions among several 'ethnic groups' from which it can no longer be differentiated except by a process of delicate analysis.

"The differences between 'races' are shown in the somatological characteristics which are the resultant of the continual struggle in the individual of two factors: variability, that is to say, the production of the dissimilar; and heredity, that is to say, the perpetuation of the similar. There are the differences in outer form, in the anatomical structure, and in the physiological functions manifested in individuals. Thus the study of these characters is based on man considered as an *individual* of a zoological group. On the other hand, the differences between the ethnical groups are the product of evolutions subject to other laws than those of biology—laws still very dimly apprehended. They manifest themselves in ethnical, linguistic, or social characteristics. The study of them is based on the grouping of individuals in *societies*."²⁶ "Thus it happens that a race may form the preponderating portion in a given ethnic group, or it may form a half, a quarter, or a very trifling fraction of it, the remaining portion consisting of others."²⁷

Community of blood between different groups, when traceable, affords a certain guide. Theoretically, the genealogical method is the only proper method to be employed for the classification of the various races of mankind. For, the concept "race" involves the idea of heredity or common ancestry; and each race represents an ancient breed or stock. But when, as in most cases, community of blood is no longer traceable—for there is hardly a pure race now existing—the diverse racial groups have to be determined and classified by considering not only those anatomical and physiological characters which are strictly common to all the individuals included in a particular group and are more or less stable and, within certain limits of variation, transmissible by heredity, but also by considering the entire ensemble of characters all of which are found in most of the individuals constituting the group and most of them in

²⁶ *Races of Man* (1900), pp. 8-9.

²⁷ *Ibid.*, pp. 281-282.

all. And the degree of fertility of unions within each such group is taken as a valuable test of the soundness of such classification. This, however, is but a theoretical test which is seldom experimentally verified. The ensemble of relatively permanent characters that form the inheritance of the group determines the race. As a corrective to such classification, the anthropologist forms a mental image of a representative or typical specimen possessing the ensemble of distinctive characters of the particular class. We should be careful, however, not to confuse "race" with "ethnic groups". For, as I have already said, there are generally individuals of more than one race in any single ethnic group (tribe, people or nation). The concept "race," as Quatrefages observes, is, "a mental product having no objective existence apart from men's minds". It is by a mental reference to this "type" that the anthropologist determines whether any particular individual or local group properly belongs to a particular race. By applying the usual method of logical division, the existing human groups are in the first instance, broadly classified, after Cuvier, in the three fundamental natural divisions to which I have already referred, viz.—

(1) The white or Caucasian race which comprises all Europeans except the Lapps and the Finns, and most western and south-western Asiatics and northern Africans.

(2) The yellow or Mongolian race inhabiting the extensive area lying east of a line drawn from Lapland to Siam and comprising most northern and eastern Asiatics besides the Finnish tribes, Lapps, the Eskimo, the Arctic Asiatic group (Chukchis and Kamchadales) and, as a modified branch, the American Indians.

(3) The black or Negro race comprising the African Negroes, Negritians, and Negrillos, the Indonesian and Oceanic Negritian, and Negritoos, and the now-extinct Tasmanians. The Australians, and other 'Pre-Dravidians' and the so-called Dravidian aborigines of India are probably Negrito-Caucasic hybrids.

In the ideal Caucasian type, the colour of the skin should be fair; the skull long or narrow; the hair soft, smooth and wavy; the face should form a narrow oval, with a strong beard and moustache in the men; the cheeks should be receding, the middle line prominent, and a slight to almost imperceptible frontal ridge; the nose slender and prominent; the eyes straight and moderately large; the lips delicate; the upper jaw orthognathous, and the jaws, as compared with the nose, receding; the teeth and cheek-bones comparatively small, the wisdom tooth or last molar being smaller than the pre-molars; a round alveolar

**Characteris-
tics of the
Caucasian
Type.**

arch ; large muscles of the seat and calves ; narrow long foot with a marked arch, and powerful heel ; and the stature fairly tall.

With regard to temperament, the Caucasian type is said to be active, enterprising, persevering, serious, stolid and reserved in the cold and gloomy northern latitudes, but gay, vivacious, fiery, impulsive and indolent in the warm luxuriant southern climes. Both northern and north-western as well as southern and south-eastern Caucasians are on the whole comparatively more intellectual and imaginative than the other races. Although quantitative differences probably exist in the mental functions of different races, the question of any fundamental difference in the mental organization of different races and any necessary correlation of race with temperament and other psychological characters is, however, by no means, as yet clearly established. It has not yet been proved that physio-psychological traits are hereditary regardless of social and natural environment. Nor can language be always definitely correlated with race. As for religion, it is not a biological inheritance but a social product—a matter of collective achievement like art, morals, ideas and systems of kinship, government and the like. The more highly evolved Caucasians have developed inflectional languages, and religions monotheistic in essence.

In the ideal Mongolian type, the colour of the skin should be from brownish-yellow to light-brown ; the skull moderately broad or short, the hair coarse, black and straight ; the face broad and flat with scanty beard and moustache, both late in appearing ; the nose small, low and broad ; the eyes black, deeply sunken, narrow, small and somewhat oblique with a peculiar fold in the inner canthus ; the teeth medium in size with a somewhat broad alveolar arch ; the cheek-bones projecting ; limbs short and the stature from medium to short. The ideal American sub-type has a yellowish colour ; mesaticephalic skull ; higher forehead ; highly developed superciliary arch ; large, bridged or aquiline, mesorrhine nose ; mesognathous jaws ; small, round, straight, black eyes ; and fairly tall stature. The Eskimo sub-type has a long head with a broad face and straight black eyes.

In temperament, the Mongolian is said to be generally sluggish and somewhat moody and sullen, although there are undoubted exceptions such as the Gurkhas of Nepal and the Lepchas of Sikkim and Bhutan. The Mongols proper in their native desert and steppes are said to be generally apathetic, sullen and reserved ; in the monsoon areas, the Mongolian, in the temperate latitudes of China and Japan, is frugal and industrious but in the tropical latitudes of Siam and Malayasia the people are indolent and reckless. The American sub-type is said to be moody,

stolid, taciturn and cautious. The Mongol's language is mainly agglutinative: post-fixes appear to be a marked feature, though isolating forms of speech linger in some sections, and the speech of the American branch is mainly polysynthetic. In religion, the Mongol, in general, is still in the polytheistic stage, and even Buddhism has not succeeded in eradicating shamanistic practices. In the American branch, polytheism and nature-worship are mixed up with animism.

In the ideal Negro type, the skin colour should be from dark-brown to black, the skull should be long; the hair of the head black, coarse and frizzly or woolly with an elliptical or oval cross-section which causes it to be closely rolled up on itself (the tufts being prominent in the Bushmen and the Hottentots); the face flat; the nose flat and broad; the jaw broad, short, and prognathous, and the lower jaw large and strong; the alveolar arch narrow and prominent; the lips thick and everted; the hair on the body scanty, and beard and moustache almost absent; the nose "squab" and broad; the eyes black, round and large; the teeth relatively large, the last molar or "wisdom-tooth" being often as large as or even larger than either of the teeth immediately in advance; the forearm long; the heels projecting; the foot short, small, strong and flat, and the calf of the leg but slightly developed; and the stature from medium to tall except in the pygmy varieties. The pelvis of the African woman is narrower and less capacious than that of the Caucasian woman.

As with his body so with his mind. The unhealthy climate of an equatorial country appears to have kept him on a low level of culture. The Negro temperament is said to be impulsive, sensuous, passionate and cruel, though generally affectionate and faithful. Improvidence and indolence are his usual characteristics. His language is agglutinative, of various prefix and postfix types; and his religion which is of the most primitive type has been described as non-theistic—ancestor-worship and fetishism being its predominant features; and superstitions about witchcraft and the evil eye are rampant.

Each of these primary races, although passing into the other by almost imperceptible gradations appears to present a series of marked differences at various points. And this is but natural; for whether there be any foundation in fact or not for the doctrine of Bathmism which postulates the presence, in all organisms, of something in the nature of an inherent growth-force tending inevitably towards divergent evolution even in a neutral environment, it is a fact of common biological observation that race is not immutably fixed but that a certain amount of plasticity inheres even in the rigid hereditary racial factors.

Even children of the same parents represent different selections from amongst the germinal elements and thus present certain variations. Besides this great individual variability, different groups of the same race settled in different climatic areas would gradually acquire through environmental and other causes such as miscegenation, "alternate inheritance", "blended inheritance," "mosaic structures" and the like, definite somatological and other peculiarities that would in time differentiate them into distinct sub-races or sub-types. Thus, for instance, in course of ages there gradually developed in different sections of the Caucasian race, every shade of colour from the fair white orthognathous Scandinavian with his wavy flaxen hair to the dusky prognathous Nubian with his frizzly dark hair; and even in the European section of the white race, there were evolved at least three distinct types, the Teutonic or Nordic with a long head and face, very light hair, blue eyes, narrow nose and tall stature; the Alpine race with a round head, broad face, light chestnut or brown hair, nut-brown eyes, generally broad though variable nose, and medium stature; and the Mediterranean race with long head and face, pale-olive colour, eyes varying from dark-brown to black, rather broad nose, and medium to short stature except in hybrid or aberrant groups, such as the Gallas and the Somalis who are tall.

To reduce to a system this confused array of groups and sub-groups, the anthropologist, in the absence of any knowledge of the actual origin and filiation of most sub-races, applies the same method of differentiation and classification by which he obtained his primary races. He marks out from each main group or race, the series of subordinate groups or sub-races and tribes which, though mutually exclusive, are distinguished from others by the possession or non-possession of some specified characteristic. The series as a whole is separated into distinct sub-groups at the points where the variations develop into marked changes in some essential characters. In this way the Caucasian type is first marked out into two broad subdivisions according to skin colour, namely, the blonde or xanthocroid Caucasian and the brunette or melanochoirid Caucasian. The blonde Caucasian with tall stature, light hair, blue or grey eyes, and florid white complexion, is mainly found in Northern Europe such as in Scandinavia, Scotland and Northern Germany; and, with more or less intermixture with the brunette or melanochoirid Caucasian who differ from the former in their somewhat shorter stature and darker complexion and colour of eyes and hair, is met with as far south and east as Northern Africa, and from the Mediterranean area extends through Asia Minor across Arabia and

Persia into Afghanistan and India. In the Lapps, Finns and some of the Siberian tribes, anthropologists recognize a blend of this type with the Mongolian. To the brunette or melanochroid division of the Caucasian race are found to belong the Aryan Hindus, the Mediterranean peoples of Southern Europe and the Semitic and Hamitic peoples of south-western Asia and Northern Africa.

Such anomalous tribes as the hairy Ainus of Japan, the Toalas of Celebes, the Mantzi of China, the Todas of the Nilgiri Hills in India, and the Veddass of Ceylon are now generally classed by anthropologists among the lower types of the brunette Caucasians with a strain of Negrito blood. Another doubtful race are the Australian natives who are found to resemble the Melanesian Negroes in their prominent brow-ridges, and the African Negroes in some other characters such as their projecting jaws, large teeth, long head, and ill-developed calves of the leg, and the lower type of brunette Caucasians in certain characters particularly in their wavy hair, well-developed beard and moustache and the general expression of their countenance. Most anthropologists regard them as a blend of some low melanochroid Caucasian stock with the now extinct round-headed frizzly-haired Tasmanians. Some anthropologists, however, would class the Australians as a separate division of mankind. Thus, according to Sir Harry Johnston, *Homo sapiens* developed out of *Homo primigenius* and differentiated into four groups: the Australoid-Neanderthaloid (very little differentiated from the Neanderthal type of man in Pleistocene Europe, and represented at the present day by the Australian aborigines and perhaps the Veddass of Ceylon), the Negro, the Caucasian, and the Mongol. Johnston opines that this Australian type was almost certainly the parent of the white man in Europe and Asia, and again gave rise to the Negro in India, Malayasia and Oceania.²⁸ Dr. A. B. Keith finds in the aboriginal Australian the nearest approach to the common ancestor of both African and European races. "He is an ancient and generalized type of humanity; he is not the direct ancestor of either African or European, but he has apparently retained the characters of their common ancestor to a greater degree than any other living race".²⁹ There appears to be little warrant, however for supposing that the Black man was metamorphosed into the Yellow and the Yellow man into the White. The probable and reasonable view, as we have seen, would appear to be that different groups of our generalized Pleistocene precursors developed under different environmental and other influences into

²⁸ *The Opening up of Africa* (London: Williams and Norgate), pp. 11-12.

²⁹ *The Antiquity of Man*, pp. 270, 271, 499, 500.

the typical Negro, the typical Mongol, the typical Caucasian.

No account of the racial affinities of the Australians should omit a mention of the Austrie theory of languages and races, not long ago put forward by Pater Schmidt of Vienna. Following up the linguistic researches of Logan, Forbes, and, in particular, Professor S. Kuhn of Munich, this German linguist and anthropologist, primarily on grounds of linguistic similarity, first put forward a theory which classed in one linguistic family the languages of various peoples such as the Munḍās of Chōtā Nāgpur and their cognate tribes in India, the Khāsis of Assam, the Mons or Talaings of Lower Burma, the Palaungs, Wa and Riang of the Salwin Basin in Upper Burma, the Khmers of Further India, the Anamese of Cochin China, the Nicobarese, and certain wild tribes of the interior of Cambodia and the Malay Peninsula, such as the Orang-Outang, the Orang-Benua, the Steings, the Bersisi, the Jakuns, the Sakais and the Semangs. This family of languages he called the Austro-Asiatic. He next propounded the still more comprehensive theory of the Austrie (*Austrich*) family of languages in which was comprised not only the Austro-Asiatic languages but also what he terms the Austronesian languages of Oceania comprising three sub-groups, the Indonesian, the Melanesian, and the Polynesian. In proof of the existence of this one "great united whole" of the Austrie family he refers to the complete agreement of their phonetic systems, the extensive agreement of their vocabulary, the original identity of their systems of word-building and the agreement in important and striking points of grammar. Pater Schmidt does not stop with classing the Mon-Khmer-Malacca-Munḍā-Nicobar-Khāsi group of tongues in one linguistic family but goes further and postulates the existence of a corresponding Austro-Asiatic race characterized by long or medium head, horizontal non-oblique eyes, broad nostrils, dark skin, more or less wavy hair and short or medium stature. This race is said to have been distinct from the Aryan race on the one hand and the Mongolian on the other. Professor Vilhelm Thomson of Copenhagen has drawn attention to some coincidences between the Kherwarian or Munḍā group of languages with those of several dialects in the southern part of Australia and suggested that the Munḍās or some closely allied tribe emigrated towards the east and south-east, probably to New Guinea and especially to the south of the Australian continent. Grierson finds "surviving traces of an old language of undoubted Munḍā character" as far west as the Lower Himalayas stretching from Kunawar in the Punjab to near Darjeeling, and opines that the stream of migration probably started not from the middle but from the extreme western end of the whole tract, and thence to have worked eastwards and

southwards".³⁰ For one thing, the frequent differences in head form between the different Austronesian tribes and the Austro-Asiatic peoples might appear incompatible with the theory of their racial unity. And, indeed, without a much more detailed investigation than has hitherto been made into the physical and cultural anthropology of all the tribes in question, the theory must be adjudged "not proven". And we are left, as before, to the Negrito-Caucasic theory of Australian origins first propounded by Flower and Lydekker, according to whom the now extinct frizzly-haired Tasmanians who were a Melanesian people represented the original inhabitants of Australia and intermixture with an emigrant people akin to the Veddas of Ceylon and representing a low form of Caucasian Melanochroi, produced the Australian "blacks". The original population of Australia supposed to be the direct descendants of Pleistocene precursors are now probably represented by the black elements in Polynesia, Melanesia, Micronesia, New Guinea (Papuan), Malaysia (the Sakais and Semangs of the Malay Peninsula, the Aetas of the Philippines and the Kalangs of Java) and the Andaman islanders.

The racial relations of the Polynesians of the Eastern Pacific and the Maoris of New Zealand, and the Mahoris and Kanakas of Micronesia also present great difficulties. While their superior height (nearly six feet), straight and in some cases aquiline and narrow noses, and frequent tendency in the hair to be wavy, have led many anthropologists to class them as a Caucasian race with an admixture of Melanesian blood, others would regard them, from their skull approximating to the broad or short type, as allied to the Mongolian Malays with an intermixture of a Melanesian element.

The typical Mongolians of northern and central Asia are found to fall into two natural groups, the
Subdivisions of the Mongolian Race. northern—Tunguse or Mongolo-Altaic group inhabiting Mongolia, Altai, Manchuria, Corea, and Northern China, and the southern group inhabiting Tibet, Southern China, Siam and Burma. The former are said to be characterized by oval or round faces and prominent cheek-bones; and the latter by square or lozenge-shaped faces with cheeks laterally enlarged. The Japanese³¹ exhibit

³⁰ Vide Grierson's review of Pater Schmidt's *Die Mon-Khmer Volker Sentalacians and Austronesians, etc.*, in the *Journal of the Royal Asiatic Society*, Vol. I of 1907, pp. 187—191.

³¹ The Japanese have been supposed to represent a blend of Caucasian, Mongolian and Malay blood. Their very white skin and intellectual qualities are traced to the Caucasian element, their short stature, lank hair and general appearance to the Mongol element, and their emotional and religious characteristics to the Malay element.

greater affinities to the former, while from the latter the Lapps, Finns, Magayars and Turks appear to have derived such admixture of Mongolian blood as they possess. To the southern group have to be referred the Tibeto-Burman tribes of Assam and the North-Eastern Frontier of India as also the Lepchas of Sikkim and Bhutan. In Bihār and Orissā, such Mongolian blood as the Thārus of the Chāmpāran district possess is also derived from the Tibeto-Burman stock. Some anthropologists would class the Nāgās of Assam together with the Mons, Kuis, Karens and Ciampos as remnants of a Palæo-Mongol stock. The Malays and such allied tribes, as the Javanese, the Sudanese, the Malagasy, the Philippinos, the Formosans, the Bugis and the Visayas form a distinct but degenerate sub-type of the Mongolian race. And the so-called Red Indians of America are generally regarded as an aberrant or modified branch of the Mongolian stock, although some anthropologists would class them as a fourth division of mankind, on the ground that this branch diverged from the Mongolian stock quite early in the history of the race and developed so many marked differences that they may very well be regarded as a distinct race. A few writers, such as Sir Harry Johnston, on the other hand, attribute the Amerindian type to a blend of the Mongolian with the Caucasian.³²

The typical Negro is represented by the African tribes south of the Equator, comprising the two
Subdivisions linguistic groups known as the Bantus and their
of the Negro southern offshoot the Kaffirs, and the dimi-
Race. native Bushmen of a yellowish-brown colour
 with their near relatives the hybrid steatopygous Hottentots. A second and modified variety of the negro stock is seen in the Oceanic negroes, which include the "mop-headed" Papuans of New Guinea and most of the natives of the group of islands in the Western Pacific known as Melanesia, besides the Kaicolos of the Fiji Islands and the negroes of Tasmania. A prominent characteristic of this type is the beetling prominence above the sockets. The typical negro, however, does not possess these prominent supra-orbital ridges which form a primitive feature so conspicuous in the Neanderthal race as in the gorilla and the chimpanzee. The nose, particularly in New Guinea, is less flattened than that of any other negritic people. The Kaicolos, it may be noted, possess the longest and narrowest skulls in the world, the mean cephalic index being so low as 62. A third variety of the Black type is represented by the negritoes who though exhibiting such typical negro features as the woolly hair and the peculiar relative proportions of the limbs characteristic of

³² *The Opening up of Africa*, p. 13.

the race differ in certain essential characters from the African and Oceanic or Melanesian type of negroes. This sub-type is represented by the round-headed diminutive Andamanese, the Aetas of the Philippines and the South-Asiatic negroids who appear to have a large strain of Malay blood and the negroid portion of the natives of the islands of Luzon and New Guinea. This pigmy sub-type known as the negrito is distinguishable from the similarly round-headed pigmy sub-type of the equatorial forests of Africa such as the Akkas, Batwas, Wochuas, Wambuttis, Babongos and Ashangos who are now generally designated as negrillos. Besides tribes and sub-races properly belonging to one or other of the three main race-divisions, there occur, as we have seen, certain anomalous tribes, some of which ³³ are accounted for as hybrids and are included, respectively, in the divisions to which they appear to have greater affinity, and some are conjecturally classed as lingering remnants of well-nigh extinct earlier degenerate varieties of one or other of the primary divisions of man. ³⁴

In thus subdividing and classifying the races of man, we have to take into account only their physical characters whereas in classifying them as ethnic groups, the geographical distribution of the different groups as well as their ethnic kinship, and cultural and linguistic characters, have, so far as possible, to be taken into consideration. Strictly speaking, however, beyond the primary race divisions, the other groupings—most of the so-called secondary or derivative races and sub-races—are more of the nature of ethnic or sociological groups than of races or somatological units. Race, as I have already noticed, is, in fact, a theoretic conception arrived at by an analysis of the physical characters common to various ethnic groups. The anthropologist, as Denniker says, ³⁵ tries “to determine by the anthropological analysis of each of the ethnic groups, the races which constitute it; then compares these races one with another, unites those which possess most similarities in common, and separates those which exhibit most dissimilarities”. “On making these methodic groupings, we arrive at a small number of races, combinations of which in various proportions, are met with in a multitude of ethnic groups.”

³³ Such, for example, as in the Black division, the Ethiopians—such as the Galla, Somali, Abyssinian, Bishari, Taraweq, and Senegal Moors—who are mainly of Caucasian origin with a strain of negro blood, and the Negroids who represent ancient hybrids between brachycephalic Caucasians—Semitic, Hamitic and Libyan—on the one hand, and the Bantus, West African negroes and Nilotic negroes, on the other. The Malagasy derived from a mixture of Mongoloid blood with the Negro inhabitants of Africa may be included either in the yellow or in the black division.

³⁴ Such, for instance, as in the White division, the Basques, the Ainus, and certain tribes of the Caucasus.

³⁵ *Races of Man* (1900), p. 281.

For purposes of easy reference, a classification of the races of mankind according to their physical affinities might perhaps be conveniently represented by genealogical tables. In these tables each group of degenerate remnants might be placed at the end of the series to which it ethnically belongs; the hybrid groups being placed apart in an intermediate position between the two main races of which they are crosses, and closer to the "dominant" than to the "recessive" ancestral race. But it is not possible to represent in a tabular form all the relations between different groups and sub-groups. For, each group or sub-group may be found to exhibit certain affinities not only with those next to it in the upper or lower part of the table, but also with others remote from it. All classifications designed to include the various human groups in one system are necessarily defective. In order to properly represent probable biological affinities, the races and sub-races require to be arranged according to three dimensions of space. But a three-dimensional arrangement is not possible on paper. Perhaps a proper genealogical tree with conventional signs to indicate degenerate types, as also crossings, would give a more feasible diagrammatic view of the relationship of the races. Besides their inherent defects, all racial classifications being as yet necessarily based on an incomplete collection and analysis of data are merely provisional and open to modification with advancing knowledge. A few schemes of race classification proposed by anthropologists have been given in appendix II.

I have now finished my hasty and imperfect account of the evolution of man and his races. In the previous lectures we have seen how Anthropology by a laborious collection and co-ordination of facts by the comparative method, seeks to determine such questions as the origin and antiquity of man, his birthplace and early migrations and his centres of specialization and radiation over the globe. In the present lecture, we have considered how as the result of various causes, known and unknown, racial variations were brought about. We have seen how, although characters produced by environment generally disappear, long protracted physiological and physico-chemical action of the same environment operating in the more plastic period of the early life of the race somehow appears to influence the germ-plasm, and variations thus induced in course of time assume stability and produce permanent modifications of type. And in this process of race-formation, while the tares perish, the grain is carefully selected. Some types, as we have seen, have been eliminated as unfit, others have remained for ages in a state of arrested development, while the fittest alone have been selected for a triumphant progress towards the goal. Thus, though races and sub-races have come and gone, and stranded

in shoals and sandbanks may be seen the laggards in the race, and strewn along the stream of evolution may be seen the flotsam and jetsam of unsuccessful races and sub-races, the great tide of human evolution, like the sacred Ganges emerging from the head of Siva, has, from the beginning, rolled on with a bend here and a turn there, now delaying and straying and again advancing and marching along the ever-broadening path of progress,—

From the hills where life arose
To the sea where it goes.

The Palæontological Record with special reference to the Remains of the Early Human Races and their Cultures.

1	2	3	4	5	6	7	8		
Geologic Periods.	Systems.	Formations.	Stages of Culture in Europe.	Human Races and early anthropoid apes.	Characteristic Fauna, especially in Central Europe and India.	Characteristic Flora, especially in Central Europe and India.	Climate, especially in Europe.		
QUATERNARY.	Recent	.....	Later Iron (Historic period up to present); Early Iron (Hallstatt); Bronze and Copper; Neolithic (in alluvium, peat, lake-dwellings, etc.).	Existing races (e.g., Mediterranean, Alpine, and Nordic in Eurasia).	Modern	Modern	Moderate.	
	Pleistocene.	Post-Glacial.	Daun Geschnitz } Bühl Achen } (Younger Loess)	PROTO-NEOLITHIC AZILIAN (including Tardenoisian).	Farfoez race	Modern with survivals of old forest fauna in Daun; Cold forest fauna (e.g., mammoth, reindeer and woolly rhinoceros) in Geschnitz; and old forest fauna as also steppe fauna (Saiga, wild ass, bison, steppe horse) in Bühl and Achen.	Pine, oak, steppe plants.	Modern, Cold temperate. Warm temperate.	
			Würm } (4th Glacial) (Upper Drift).	MAGDALENIAN	Cremagnon race.	REINDEER; stag; mammoth; musk-ox; Rhinoceros tichoridus.	Arctic willow, dwarf birch.	Arctic.	
				Riss-Würm } (3rd Inter-Glacial) (Middle Loess).	SOLUTRIAN and AURIGNACIAN.	Aurignacian and Grimaldi (negroid) races.	HORSE; reindeer; rhinoceros lehorinus; Rhinoceros Merckl, hippopotamus, cave-bear, Elephas antiquus.	Pine; birch. Steppe plants. Conifers.	Cold temperate. Warm temperate.
					Riss } (3rd Glacial) (Middle Drift).	UPPER MOUSTÉRIAN. LOWER MOUSTÉRIAN. UPPER ACHÉULIAN.	Neandertal race.		
			Mindel-Riss } (2nd Inter-Glacial) (Older Loess).	LOWER ACHÉULIAN		Neandertal race	MAMMOTH; reindeer, musk-ox	Tundra; birch scrub.	Arctic.
				Mindel } (2nd Glacial) (Old Drift).		CHELLEAN UPPER STREPTAN. LOWER STREPTAN. MESVINIAN. MAFFLIAN.		MAMMOTH (Elephas primigenius); Elephas antiquus; Elephas meridionalis; rhinoceros crassus; cave-bear; hippopotamus.	Luxuriant forest vine; walnut, etc.	Warm and wet.
			Gunz-Mindel } (1st Inter-Glacial) (or St. Prestin).		EOLITHS BOUSTO-CABINATE	Homo Heidelbergensis Eoanthropus Dawsonii.	Rhinoceros merckl; Elephas antiquus; Elephas meridionalis; Rhinoceros leptorhinus; Rhinoceros crassus.	Semi-tropical forest.	Warm and wet; transitional.
			Gunz } (1st Glacial) (or 'Old Terraces').	BOUSTO-CABINATE BEUTLIAN.		RHINOCEROS ETRUSCUS	Tundra; birch scrub.	Arctic.	
			TERTIARY (Cenozoic).	Pliocene	...	EOLITHS (St. Prestin).	Pithecanthropus erectus. Anthropoid apes [Pithecanthropus (Siwaliks), Neopithecus (Germany), Pseudopithecus (Pithecanthropus?)]	MARTOPON: Sigodon; Elephas meridionalis; (Siwaliks) Machirolus; tapirs; Hypotherium antelopinum; rhinoceros (in India). Hippopotamus, Macraques (Asia and Europe).	Semi-tropical forest; varied fauna of dicotyledonous.	Semi-tropical (gradual refrigeration); warm mild towards the close.
Miocene	...	EOLITHS (probably the earliest traces of primitive man).		Anthropoid apes:—Pithecanthropus (Siwaliks) in India, Dryopithecus in Hungary, France, etc., Pithecanthropus in Europe and Asia, Mesopithecus in Greece, Oreopithecus in Tuscany).	MARTOPON; Dinotherium and Meladotherium (Siwaliks).	Luxuriant vegetation: walnuts; oak; palms; bamboos; figs; magnolia; poplar; conifers.	Sub-tropical.		
Oligocene	...	Doubtful Eoliths or pre-Eoliths.		Anthropoid apes: [Protopithecus, Maripithecus, Parapithecus, in Africa.]	[Higher mammals:] Rhinoceros tapirus; Anthracotherium. Small Monkeys (Egypt).	Cypress (in Europe); palms, and large-leaved monocotyledons.	Oscillations of climate.		
Eocene	...	.....		[Probably the common ancestral stock of the Anthropoidea lived in this period.] Homunculus Patagonicus in America.	[Primitive Carnivora.] Unitherium; Palaeotherium; Anoplotherium; Microsorex; Nummulites. Small Monkeys and lemurs.	Monocotyledons	Warm temperate on the shores of the Tethyan sea; tropical in places; cooler in the northern hemisphere.
Paleocene	...	.....		.....	.....	.....	.....
SECONDARY (Mesozoic).	Cretaceous	...	.....	.....	Birds and Early Mammals	Dicotyledonous angiosperms.	Mainly similar to Recent with oscillations towards tropical or boreal at intervals.
	Jurassic	...	.....	.....	Earliest Mammals; Sponges, corals, gastropods.	Gymnosperms; conifers; cycads.	
	Triassic	...	.....	.....	Flying dragons, fish-lizard; reptiles.	Tree ferns; scabellity.	
PRIMARY (Palaeozoic).	Permian	...	.....	.....	First reptiles; ganoid; nautilus	Cryptogams and gymnosperms (cordates). Lycopods; algae (seaweed); dicotyledons.	
	Carboniferous	...	.....	.....	First land creatures, precursors of amphibians and crocodiles.		
	Devonian	...	.....	.....	Fish.		
	Silurian	...	.....	.....	First fishes.		
	Ordovician	...	.....	.....		
	Cambrian	...	.....	.....	Trilobites. (Invertebrates.)		
ARCHÆAN OR PRE-CAMBRIAN (Eozoic).	...	...	.....	.....	Eozoon (P); foraminifera P		

NOTE.—As mentioned in Lecture II, the authoritative estimates of the duration of the different geological formations are merely speculative and widely divergent. Thus the various estimates for the duration of the Pleistocene age range from 400,000 years to 1 million years, of the Pliocene from half a million to $7\frac{1}{2}$ million years, of the Miocene from 800,000 to 14 million years, of the Oligocene from 1,200,000 to 18 million years, and of the Eocene from 1,200,000 years to 26 million years.

Although there is practical unanimity among experts as to the sequence of the different culture periods and human types in the Glacial and Post-glacial phases, there appear to be certain differences of opinion as to their respective geological ages (the phases of the Pleistocene age to which they respectively belong). Perhaps *Homo Heidelbergensis* should be placed in the second Inter-glacial rather than the first, and *Eoanthropus* not much earlier. A Tertiary antiquity is however claimed by some experts for *Eoanthropus*.

APPENDIX II.

DIFFERENT SCHEMES OF CLASSIFICATION OF THE
EXISTING RACES OF MAN.

(i).—CLASSIFICATION OF THE HUMAN RACES,

AFTER DR. HADDON.

A simple classification of the existing races of mankind is that on the basis of the character of the hair as given by Dr. Haddon in his *Races of Man*. This scheme involves or implies no particular theory of racial or geographical origins and may be represented, with certain elaborations, as follows :—

I.—ULOTRICH I.

A.—The Pygmy Ulotrichi :—

(a) **Negritoos** [comprising (1) the very dark brachycephalic *Andamanese*, (2) the mesocephalic *Semangs* of the Malay Peninsula and Sumatra, of a dark chocolate brown skin, and (3) the mesocephalic *Aetas* of the *Philippines*, of a dark sooty brown colour].

(b) **Negrillos** [mesocephalic pygmies of the equatorial forest of Africa ; of a dark rusty brown colour].

B.—Short, Yellow-skinned Ulotrichi :—

(a) **Bushmen** of South Africa [dolichocephals, the most platyrrhine of all mankind].

(b) **Hottentots** of south-west Africa [dolichocephals ; a cross between Bushmen and Hamites or Bantus].

C.—Short or Tall, Dark-skinned Ulotrichi :—

(a) **True Negroes** [comprising (1) *Nigrilians* or *Western Sudanese Negroes*, and (2) *Nilotic* or *Eastern Sudanese Negroes*].

(b) **Bantus** of Central and Southern Africa [a cross between the true Negro and Hamitic or other elements].

(c) **Papuans** of New Guinea [originally throughout Melanesia, Australia and Tasmania].

(d) **Melanesians** [extending from Bismarek Archipelago to New Caledonia, Fiji and some parts of New Guinea].

II.—CYMOTRICH I.

A.—Dolichocephalic Cymotrichi, with dark-brown to nearly black skin (melanous) :—

(a) **Veddahs** of Ceylon. [Primitive survivals of a Pre-Dravidian race.]

(b) **Jungle Tribes of the Deccan** [e.g. *Kadirs*, *Kurumbas* and *Irulas*, etc.].

(c) **Sakais** and other jungle tribes of the Malay Peninsula and East Sumatra. [Though mixed with other people, they are mainly of Pre-Dravidian origin.]

(d) **Toalas** of Celebes [of Pre-Dravidian stock, though some mixture has taken place (brachycephals)].

(e) **Australians** [probably mainly of Pre-Dravidian stock, some, at any rate, having mixed with a Papuan population that preceded them in Australia].

(f) **Dravidian**.—[Some so-called Dravidians exhibit traces of a Pre-Dravidian origin.]

(g) **Ethiopians or Hamites** of North-East Africa.—[Mesocephalic (index 75-78). These represent perhaps a very ancient admixture of Semite with Negro, and include ancient and modern Egyptians (in part)].

B.—Dolichocephalic Cymotrichi of fairest white colour:—

Nordics or “Teutonic Race”.—[They are the fairest of all peoples and had their original home in North Europe.]

C.—Dolichocephalic Cymotrichi of tawny white colour:—

(a) **Mediterraneans**.—[Their present distribution is mainly round the shores of the Mediterranean. The Ancient Egyptians (in part), the Lybians, Iberians, Ligurians and Pelasgians, and the dolichocephalic neolithic inhabitants of Western Europe and the British islands belonged to this stock.]

(b) **Semites**.—[The most pure type, with a narrow straight nose, is found among the Arabs of South Arabia. The Jews are a mixed people who may have acquired their so-called “Jewish nose” from the Assyroids or Hittites (now probably represented by the Armenians).]

D.—Dolichocephalic Cymotrichi of Intermediate Shades:—

(a) **Indo-Afghans**.—[Dark brunette; with a tawny skin, often rather light, found throughout the East Indian Archipelago and extending into Further India.]

(b) **Indonesians**.—[It is difficult to isolate the Indonesian type as it has almost always mixed with a brachycephalic Proto-Malay stock, but the Muruts of Borneo (cranial index, 73) are probably typical. Generally mesocephalic (index 76-78), probably originally dolichocephalic.]

(c) **Polynesians**.—[Extending from Hawaii to New Zealand and from Samoa to Easter Island. “These may be regarded as a mixed variety of the Indonesian race which has greatly increased in stature, 1.72 m. (5 feet 7½ in.). Dolichocephaly and mesocephaly are widely spread in Polynesia, but there are brachycephalic centres in Tonga, the Marquesas and the Hawaiian islands; the broadening of the head is probably due to an early mixture with a Proto-Malay stock; nose prominent; sometimes convex.”]

E.—Mesocephalic Cymotrichi:—

Ainu of Japan.—[The indigenous population of Japan characterized by long heads (C. I., 77.8), broad face and nose, large horizontal eyes and a great profusion of black wavy hair. Balz regards them as more or less related to the Alpine or “Celts-Slavic” Race; but Denniker classes them as Palæasiatics and Keane places them, along with Semites and Dravidians, in the *Homo Mediterraneanensis* group of the “Caucasic Peoples”.]

F.—Brachycephalic Cymotrichi:—

The Alpine Race.—[This race, mainly found in the plateaux and mountains extending from the Himalayas through Asia Minor and the Balkan Peninsula to Central France and Brittany, consists of a short and a tall variety. It is subdivided into: (1) *Cevanole*, or the short (5 feet 4–4½ inches), brachycephalic (index 85-87), thick-set variety, with a dull white skin mainly occurring in Europe; (2) *Dinari* or *Adriatic*, a tall variety (5 feet 6–7½ inches) probably an offshoot

of the Australian; (3) *Anatolian* or *Armenian*, with a tawny white skin, head (index 85-87) very flat behind, and an aquiline nose with a depressed tip and large wings.

"The Armenians appear to be modified representatives of an ancient Hittite stock".]

III.—LEOTRICHI (*mainly brachycephalic*).

A.—Asiatic Leotrichi (of various shades of yellow skin-colour).

(a) **Palæasiatics or Eastern Siberians** of the north-east corner of Asia.—[Comprising the *Yukaghirs*, *Koryaks*, *Chukchis*, *Kamchadales* and *Gilyaks*. Their eyes are oblique and the head often mesocephalic. Some Gilyaks have beards and more regular features, probably due to admixture with the Ainu.]

(b) **Tungus**.—[Subject to considerable variations. The northern members, e.g. the *Tungus*, *Orochons*, *Lamuts*, and *Gold*, mainly resemble the Palæasiatics. The *Manchus* are taller, sligher and with a tendency to mesocephaly.]

(c) **Koreans**.—[Tall and slender, brachycephalic (index 82), with aquiline nose, and eyes with Mongolian fold.]

(d) **Mongols**.—[Short (5 ft. 3½ in.), brachycephalic (index 82-84), with a low vault and Mongolian eyes. Typical Mongols are the Sharras of whom the Khalkas of the Gobi area are the most important. The Kalmuks live to the west of the Khalka country. The Buryats to the north are somewhat mixed.]

(e) **Turki**.—[With a brachycephalic high head (index 85-87), medium stature (5 ft. 6 in.), with a tendency to obesity, elongated oval face; straight somewhat prominent nose, non-Mongolian eyes. Some have much hair on the face. They fall into three groups: (1) the *Eastern* group comprising the *Yakuts* of the Lena basin and certain so-called *Tartars*; (2) the *Central* group comprising the *Kirghiz*, *Kazaks*, *Uzbeks*, etc., of Russian Turkestan; and (3) the *Western* group composed mainly of the *Turkomans*, east of the Caspian, and of the *Osmanli* in Asia Minor and Turkey.]

(f) **Ugrians**.—[Either mesocephalic or brachycephalic, with straight or concave nose and projecting cheek-bones. The peoples of Western Siberia, e.g. the *Ostyaks*, *Tuba*, *Voguls*, *Samoyads* mainly belong to this group; the *Votyaks* and *Cheremiss* have penetrated into Russia, and the *Lapps* into Northern Scandinavia. The *Finns*, *Esthonians*, *Livonians*, *Bulgars*, *Magayars*, and some other branches of this stock have been greatly modified by migrating into Europe.]

(g) **Indo-Chinese, Pareans or Southern Mongols**.—[Generally short (averaging about 5 ft. 3 in.); brachycephalic (index 80-85); frequently prognathic, nose short and broad, often very oblique eyes, with Mongolian fold. Skin colour varying from yellowish in the north to olive and copper-brown in the south; mostly mixed with other races. The *Tibetans*, *Himalayans*, *Chinese proper*, and the bulk of the populations of Further India and Indo-China belong to the group. "Those members who spread into the East Indian archipelago are often called *Oceanic Mongols*, but a better term is Proto-Malays; and it is from these that the true Malay is derived."]

B.—American Leotrichi.

(a) **Dolichocephalic American Indians**.—[These may be divided into two groups:

- (1) **Eskimo** with a brownish or reddish-yellow complexion, broad faces; projecting cheek-bones, straight black eyes;

- (2) **Palæ-Amerinds** with wavy or even curly hair (e.g. the Botocudos.)

(b) **Mesocephalic or Brachycephalic American Indians—**

[These consist of the following subdivisions :—

- (1) **Patagonians** [with brachycephalic head (index 85), brown colour, tall stature (5 ft. 8 in.—6 ft.), and square face. Traces of this stock are found in Central South America].

- (2) **Southern Amerinds** [with mesocephalic or brachycephalic head, yellow-skin, smooth body, straight or concave nose, and short stature].

(c) **Central Amerinds** [with brachycephalic head, brownish-yellow or brown skin, low stature, and straight or aquiline nose].

(d) **North-Western Amerinds** [of the Pacific slope, with brachycephalic head, medium stature (5 ft. $5\frac{1}{4}$ in.— $6\frac{1}{2}$ in.), and, usually, a rounded face].

(e) **Northern Amerinds** [of the Atlantic slope, with mesocephalic head, warm yellow skin, oval face, straight or aquiline nose ; and stature above the average (5 ft. 6 in.—5 ft. 9 in.)].

(ii).—**CLASSIFICATION ADOPTED IN KEANE'S "MAN:
PAST AND PRESENT".**

This scheme of classification on the basis of character of the hair is represented in the revised edition (1920) of Keane's *Man: Past and Present*, in a more simplified form, as follows:—

I.—ULOTRICHI (WOOLLY-HAIRED).

1. The African Negroes, Negrillos, Bushmen.
2. The Oceanic Negroes: Papuans, Melanesians in part, Tasmanians, Negritoës.

II.—LEOTRICHI (STRAIGHT-HAIRED).

1. The Southern Mongols.
2. The Oceanic Mongols, Polynesians in part.
3. The Northern Mongols.
4. The American Aborigines.

III.—CYMOTRICHI (CURLY OR WAVY-HAIRED).

1. Pre-Dravidian: Vedda, Sakai, etc., Australians.
 2. The "Caucasic" people:—
 - (a) Southern Dolichocephals: Mediterraneans, Hamites, Semites, Dravidians, Indonesians, Polynesians in part.
 - (b) Northern Dolichocephals: Nordics, Kurds, Afghans, some Hindus.
 - (c) Brachycephals: Alpines, including the short Cevenoles of Western and Central Europe, and the tall Adriatics or Dinaries of Eastern Europe and the Armenians of Western Asia.
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CLASSIFICATION OF THE RACES OF MAN,

AFTER DENNIKER.

A more elaborate classification is that given by Denniker in his *Races of Man*. Taking skin-colour and the character of the hair as the main bases of classification, Denniker classifies the races and sub-races of man in six natural groups which he subdivides into twenty-nine races and sub-races. His classification and description of the twenty-nine groups may be usefully combined, and represented by the following tables :—

Races and Sub-Races.

A.—Woolly Hair (*Ulotrichous*), Broad Nose :

Yellow skin ...	Steatopygous, short-stature, dolichocephalic.	1. Bushman or <i>Bushman-Hottentot</i> [relatively pure among the <i>Bushman</i> and less pure among the <i>Hottentots</i>].
The Negroid Group.	Dark Skin...	Reddish-brown, very short-stature, either sub-brachycephalic or sub-dolichocephalic.
		2. Negrito [Falling into two sub-races:—(1) The <i>Negrillos</i> of Africa of which the pure representatives are the Akkas, the Batuas and other sub-dolichocephalic pygmies ; and (2) the <i>Negritoes</i> of Asia (Andamanese, Black Sakai, Aetas, etc.) who are mesocephalic or sub-brachycephalic and a little taller in stature than the <i>Negrillos</i> .] [Influence of the Negrito type on that of the <i>Malays</i> , the <i>Jahuns</i> , certain <i>Indonesians</i> , etc., is well recognized.]
		Black, tall stature, dolichocephalic.
		3. Negro [subdivided into two sub-races:—(1) the <i>Nigrilians</i> of the Sudan and of Guinea, more prognathous (or more “negroid”) than (2) the <i>Bantus</i> of Southern Africa. (The Negro element is strongly represented in the mixed populations of Africa, e.g. certain Berbers and Ethiopians and the islanders of Madagascar.) Most Negroes of America belong to the Negritic sub-race].

		<i>Races and Sub-races.</i>	
The Negroid Group.	Dark Skin...	Brownish black, medium stature, dolichocephalic; skin-colour lighter and hairless woolly and with broader spirals than among the Negroes.	4. Melanesian [with two sub-races:— (1) <i>Papuan</i> , with elongated ovoid face and hooked nose, (especially prevalent in New Guinea, but also entering into the composition of several mixed tribes of Celebes, Gilolo, Flores, Timur, and other islands of the Asiatic Archipelago further east); and (2) the <i>Melanesians</i> proper with squarer and heavier face occupying the rest of Melanesia].

B.—Curly or Wavy Hair—(*Cymotrichous*).

Dark Skin	...	Reddish-brown, narrow nose, tall stature, dolichocephalic.	5. Ethiopian. [This type is preserved fairly pure among certain <i>Bejas</i> and the <i>Gallas</i> , but is modified by admixture of Arab blood among the <i>Somalis</i> , <i>Abyssinians</i> , etc. and by Negro blood among the <i>Zandebs</i> (<i>Niam-Niam</i> , etc.) and the <i>Fulbes</i> or <i>Fulahs</i> .]
	...	Chocolate-brown, broad nose, medium stature, dolichocephalic.	6. Australian. [According to Denniker, this type is remarkable for its unity and its isolation. Even their nearest neighbours, the now extinct Tasmanians, had a different type.]
	...	Brownish-black, broad or narrow nose, short stature, dolichocephalic.	7. Dravidian or South-Indian [presenting, according to Schmidt, two varieties or sub-races:—(1) <i>Leptorrhinean</i> , with thin nose and very elongated head, e.g. the <i>Nairs</i> , etc.; and (2) <i>Platyrrhinean</i> , with very broad nose and a somewhat shorter head (<i>Dravidians</i> proper). The <i>Veddas</i> come much nearer to the Dravidian type, which also penetrates among most of the populations of India.]

Races and Sub-races.

	}	...	Narrow, hooked nose, with thick top, bra- chycephalic often united eyebrows and thick lower lip.
Tawny white skin.			

8. Assyroid [a type clearly represented on the Assyrian monuments, but no longer found pure, though counting a sufficient number of representatives to give a character to such peoples as the *Hadjemi Persians*, the *Assyores*, certain *Kurdish tribes*, and some *Armenians* and *Jews*. The *Todas*, Denniker thinks, partly belong perhaps to this type].

C.—Wavy, Brown or Black Hair, Dark Eyes.—
(Melanochroid Caucasian.)

Clear brown skin and black hair.	} Narrow, straight or convex nose, tall stature, dolicho- cephalic.
----------------------------------------	------------------------------------------------------------------------------------

9. Indo-Afghan. [This type has its typical representatives among the Afghans, the Rajputs, and the Brahmins, but greatly varied through crosses with Assyroid, Dravidian, Mongol, Turkish, Arab and other elements.]

Aquiline nose,
prominent occiput,
dolichocephalic,
elliptical face.

10. Arab or Semite
[Represented by typical individuals among the *Arabs* and certain *Jews*. Features of this type are often found in most of the populations of Syria, Mesopotamia, Beluchistan, Egypt and the Caucasus.]

Straight coarse
nose, dolichcephalic,
square face.

11. **Berber.** [Subdivided by Dr. Collignon into four varieties or 'types', viz. the *Djerba* sub-race with short stature and globular head (c.i., 78 to 81·7), the *Ellis* type with long head and broad face, the dolichocephalic *Berber* proper of Algeria-Tunisia with narrow face and stature above the average, and the *Jerid* or *Oasis* type of somewhat lofty stature and dark complexion. Among the nomad Berbers may be mentioned the *Tuaregs* of Western Sahara and *Maghrebi* who roam over the plateaux east of the Nile. The *Bedouins* of Egypt are Berber Arabs divided into numerous tribes.]

Tawny white
skin, black
hair.

Tall sta-
ture, elon-
gated
face.

The North African Group.

Races and Sub-Races.

Tawny white skin, black hair.	Tall stature, elongated face.	The North African Group.	Straight fine nose, sub-dolichocephalic or mesocephalic, oval face, tall stature.	12. Littoral-European or <i>Atlanto-Mediterranean</i> race [found in a pure or mixed state along the shores of the Mediterranean from Gibraltar to the mouth of Tiber, and on several points on the Atlantic coast from the straits of Gibraltar to the mouth of the Guadalquivir, on the Bay of Biscay, etc. (corresponding pretty well to the <i>Mediterranean</i> race of Houze, and the Cromagnon race of certain authors). Probably connected with this Littoral race is a secondary race (tall, sub-dolichocephalic with chestnut hair, almost brown) found chiefly in the north-west of Ireland, in Wales, and the east of Belgium].

Short stature, dolichocephalic, often curled hair, very dark eyes, straight or turned-up nose.

13. Ibero-insular [chiefly found in the Iberian Peninsula and in the islands of the Western Mediterranean. This is the *Mediterranean* race of Sergi and the *Homo meridionalis* of Risley].

Dull white skin, brown hair.	Short stature, strongly brachycephalic, round face.	14. Western European or Cevenole [with its characteristic type in the extreme west of Europe, in the Cevennes, on the central tableland of France, and also in the Western Alps. It is the <i>Celtic</i> or <i>Rhetian</i> race, the <i>Celto-slav</i> , <i>Ligurian</i> or <i>Celto-Ligurian</i> of some anthropologists and the <i>Homo Alpinus</i> of others].

Races and Sub-Races.

- Tall stature, brachycephalic, elongated face, delicate, straight or aquiline nose.
- Dull white skin, brown hair.
- 15. Adriatic or Dinaric.** [With its purest representatives along the coast of the Northern Adriatic and especially in Bosnia, Dalmatia and Croatia. They are also found in Rumania, Venetia, among the Slovenes, the Ladinis of the Tyrol, the Romansch of Switzerland, etc. Probably connected with this race is a secondary race (medium stature, less brachycephalic and with lighter hair and eyes) found in Perche, Champagne, Alsace-Lorraine, the Vosges, Franche-comte, Luxemburg, Zealand (Holland), the Rhenish provinces, Bavaria, south-east Bohemia, German-Austria, the central district of the Tyrol, and a part of Lombardy and Venetia.]

D.—Fair, Wavy or Straight Hair, Light Eyes.

- Somewhat wavy reddish hair, tall stature; elongated dolichocephalic head, light eyes, for the most part blue; prominent straight nose.
- Reddish white skin (Xanthoeroid Caucasian).
- 16. Northern European.**—[The most typical representatives of this type, pure or slightly modified, are found in Sweden, Denmark, Norway (except the west coast), northern Scotland, east coast and north of England, Ireland (except the north-west), northern Faroe Isles, Holland (north of the Rhine), Frisian country (Oldenburg, Mecklenburg, Schleswig-Holstein), in the Baltic provinces of Russia, and among the Tavasts of Finland. To this is related a secondary race (mesocephalic, straight hair) called *Sub-northern* found especially in Northern Germany, among the *Letto-Lithuanians*, in Finland and on the west coast of Norway.]

Reddish white skin
(Xanthocroid Caucasian). { Somewhat straight flaxen hair, short stature, square-cut face; nose frequently turned up, blue or grey eyes, sub-brachycephalic.

Races and Sub-Races.

17. Eastern European.—[With its representatives in the east of Europe, e.g. the *White Russians*, the *Polish-chooki* of the Pinsk marshes and certain *Lithuanians*. Blended with others, this type is frequent among the *Great Russians* of Northern and Central Russia as also in Finland and Eastern Prussia. "Connected with this race is a secondary race, *fair, mesocephalic, of very short stature (Vistulian race)*, the characters of which are frequently met with among the *Poles*, the *Kashoobs*, and probably in Saxony and Silesia".]

E.—Straight or Wavy Hair, Dark, Black Eyes.

Light brown skin. { Very hairy body, broad and concave nose, projecting cheek-bones, lozenge-shaped face, dolichocephalic or mesocephalic.

18. The Ainu race.—[Preserved fairly pure among the Ainus, the type forms one of the constituent elements of the populations of Northern Japan.]

Prominent nose (sometimes convex), tall stature; elliptical face, brachy- or mesocephalic.

Yellow skin,
smooth body.

Short stature, flattened nose (sometimes concave), projecting cheek-bones, lozenge-shaped face, dolichocephalic.

The Oceanic Group.

19. Polynesian.—[Found more or less pure from the Hawaiian islands to New Zealand, undergoing changes in the west of Polynesia owing to intermixture with the Melanésians (Fiji, New Guinea), and furnishing perhaps a more hirsute sub-race in Micronesia.]

20. Indonesian.—[Represented by the *Dyaks*, the *Battas*, and other populations of the Malay Archipelago (Nias, Kubus) or of Indo-China (Nobarese, Nagas), and modified by intermixture with Negrito elements (e.g. White Sakai), or with Hindus (e.g. Malays, Khamtis), *Papuans* (e.g. Natives of Flores).]

*Races and Sub-Races.***21. South American.**—

[With probably two sub-races:—(1) the dolichocephalic *Palæo-American* type, with hair often wavy or even frizzy, perhaps derived from the oldest inhabitants of the continent; and (2) the mesocephalic *South American* type with straight hair.]

Yellow skin,
smooth body.

{ Short stature, prominent straight
or concave nose, meso- or dolichocephalic.

F.—Straight Hair (Leotrichous.)

{ Straight or
aquiline nose.

{ Tall stature, mesocephalic.

{ Short stature, brachycephalic with
straight or aquiline nose.

Warm yellow
skin.

{ Deep brown colour, straight nose, tall
stature, brachycephalic, square face.

{ Short stature, round flattened face,
dolichocephalic.

Brownish yellow
skin.

22. North American.—

[With two sub-races: (1) *Atlantic*, mesocephalic, of very tall stature (e.g. the Siouans) and (2) *Pacific* (e.g. the Thlinkits) differing from the former by short stature, more rounded head, and better developed pilous system.]

23. Central American.—

[Frequently met with on the Pacific slope of the two Americas as well as on several points of the Atlantic slope of South America. In the former region the population is principally formed of a blending of this type with the North American race; in the latter with the South American race.]

24. Patagonian.—

[Having representatives among the Patagonians and certain peoples of Chaco and the Pampas.]

25. Eskimo.—

[Fairly pure on the east coast of Greenland and in the north of Canada, but modified by intermixtures with the North American race in Labrador, Alaska, and on the west coast of Greenland (where there is a further intermixture with Northern Europeans), and with the Mongolic races (Chukchi, Aleuts, etc.) on the shores of the Bering Sea.]

Races and Sub-Races.

Yellowish white skin.	{	Turned-up nose, short stature, brachy- cephalic.	26. Lapp. —[Fairly pure among some Scandinavian Lapps; but elsewhere blended with the northern and eastern races (Scandinavians, Finns, Russians).]
		Straight or concave nose, short stature, meso- or dolicho-cephalic, projecting cheek-bones.	27. Ugrian. —[Predominates among the eastern Finns (Ostiaks, Votiaks, Permiaks, Zyrians, Mordvinians and Cheremiss), and perhaps as a variety among the Tubas or Yeniseians. It is found again interblended with the <i>Samoyeds</i> , and perhaps with the <i>Yakuts</i> .]
	{	Straight nose, medium stature, strongly brachycephalic.	28. Turkish or Turkic Tatar. —[The type, fairly pure, is common among the <i>Kirghiz</i> and the <i>Tatars</i> of Astrakhan, but in other ethnic groups it is weakened by intermixture with such races as the <i>Mongolo-Tunguse</i> (<i>Yakuts</i>), <i>Ugrian</i> (<i>Shuvashes</i>), <i>Assyroid</i> (<i>Turkomans</i> , <i>Osmanli</i> Turks, etc.).]
Pale yellow skin	{	Projecting cheek-bones, Mongoloid eyes, slightly brachycephalic.	29. Mongol. —[Comprising two sub-races: <i>Tunguse</i> or <i>Northern Mongolian</i> , with oval or round faces and prominent cheek-bones, spread over Manchuria, Corea, Northern China, Mongolia; and <i>Southern Mongolian</i> with lozenge-shaped or square faces and cheek-bones laterally enlarged, especially in Southern China and Indo-China.]

As the above table does not exhibit the affinities of these twenty-nine racial groups *inter se*, Denniker arranges them in the following table in such a way as to bring the most closely connected races near together. "This table," Denniker says, "shows us clearly that the Bushman race, for example, has affinities with the Negritoes (short stature) and the Negroes (nature of the hair, form of the nose); that the Dravidian race is connected both with the Indonesian and the Australian; that the place of the Turkish race is, by its natural affinities, between the Ugrians and the Mongols; that the Eskimo have Mongoloid and American features; that the Assyroids are closely related to the Adriatics and the Indo-Afghans; that the latter, by the dark colour of their skin, recall the Ethiopians and the Arabs by the shape of the face, etc."¹

¹ *Races of Man* (1900), p. 287.

GROUPING OF THE HUMAN RACES ACCORDING TO THEIR AFFINITIES (Donniker).

Patagonian.	XIII North American. Central American. South American.	XII Polynesian. Indonesian.	XI Ainu.		
			V Dravidian.	IV Australian.	II Melanesian.
	XIV Eskimo.	XVII Mongolian.			Nigrito.
			VI Assyroid.	I Bushmen.	Negro.
	XV Lapponic.	XVI Ugrian.			III Ethiopian.
		Turkish.		VII Indo-Afghan.	
	IX Eastern European. Northern European.		X Western European. Ibero-Insular.	Adriatic. Littoral.	VIII Arab. Berber.

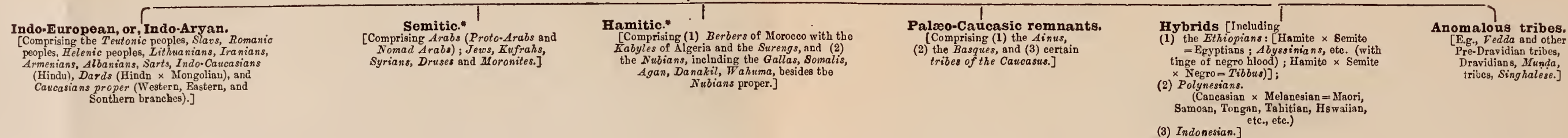
Addendum to Foot-note (14) to page 109, ante.

As regards the two stone adzes of the Burmese (shoulder-headed) type found in the Dhalbhum pargana of the Singhbhum district of Chota Nagpur, their finder V. Ball was uncertain (and as it appears to me rightly so) as to whether they were imported or indigenous. As for Assam, however, the two shoulder-headed stone celts now in the Indian Museum (Nos. 6103 and 6114 in the Museum register) are undoubtedly genuine artifacts of the province. *Vide Proceedings of the Asiatic Society of Bengal*, 1875, pages 118—122; *Journal of the Asiatic Society of Bengal* (new series), Vol. IX, 1913, page 291.

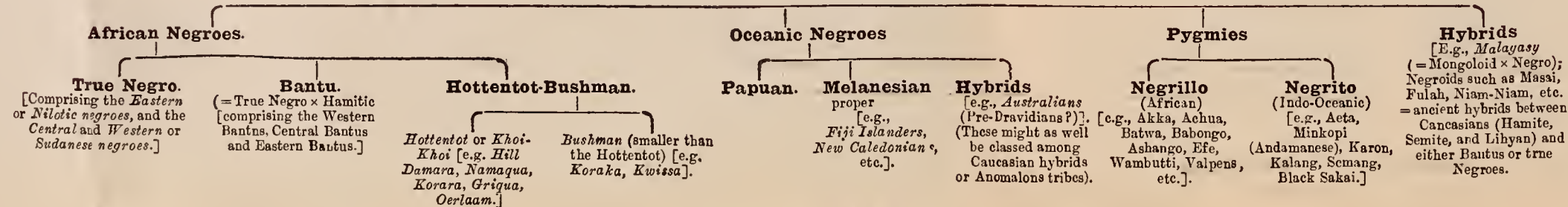
IV.—A GENERAL CLASSIFICATION OF THE RACES OF MAN.

By combining, to some extent the physical characters with the ethnic (including linguistic) characters of the different human groups and also taking their geographical distribution into consideration, a general classification of human races and sub-races may be roughly represented by the following tables:—

1. The White or Caucasian Race.



2. The Black Race.



* Although, the names Semitic and Hamitic and even Aryan are liable to exception on good grounds, they are retained for want of better substitutes. According to physical features the Caucasian peoples fall into three types, the Nordic, the Alpine, and the Mediterranean. The Nordic type comprises the Scandinavians, Scotch, most English, some Irish, Dutch, Flemings, Thraco-Hellenes, true Kurds, most West Persians, Afghans, Dards, and Siah-posh Kafirs; the Alpine type comprises most French, South Germans, Suris, Tyrolese, Russians, Poles, Chekbs, Yugo-slavy, some Albanians and Rumanians.— Armenians, East Persians (Tajiks) and Galchas; and the Mediterranean type comprises Semitics and Hamitics, some Hindus, some Greeks, most Iberians, Corsicans, Sardds, Sicilians and Italians. Many anthropologists consider the Dravidians, the Todas, Ainns, Indo-Asians and some Polynesians as belonging to the Mediterranean type of the Caucasian race.

3.—Yellow Race.

Northern Mongols or Mongolo-Turki.

Mongol proper comprising (1) *Sharra* or Eastern Mongol, (2) *Kalmuk* or Western Mongol, (3) *Buriat* or Siberian Mongol, and (4) *Tungus* (Manchu, Oroch, etc.).

Siberian [*Chukchi*, *Koryak*, *Gilyak*, *Yukghir*, *Kamchadale*].

Koreo-Japanese [comprising (1) *Korean*, (2) *Japanese*, (3) *Lieu-kiu*].

Finno-Ugrian [comprising (1) *Volga-Finn*, (2) *Baltic Finn*, (3) *Ugrian*].

Turki [comprising (1) *Turki proper* (e.g. *Uzbeks*, *Yakuts*, *Tartars*, etc.), (2) *Kirghiz*, (3) *Karakalpak*, (4) *Turkoman*].

Southern Mongols. (Indo-Chinese or Pareaceans)

Tibetans [including *Tibetans proper*, *Gurkhas*, *Bhotiyas*, *Ladakis*, *Tanguls*, *Chin hill-tribes* such as the *Lolos* and *Miotsze*].

Sifan [e.g. *Abor*, *Dajla*, *Miri*, *Mishmi*, *Mech*, etc.].

Tai-shan [including *Shan*, *Khamti*, *Ahom*, *Lao*, *Siamese*].

Oceanic Mongols.

Philippines.

Formosans.

Malaysians.

[Comprising *Malay proper*, e.g. *Johar*, and *Proto-Malayas* (e.g. *Dayaks*, etc.), *Perak*, etc.]

Giao-Shi [including *Anamese*, *Cambojan*, *Mon*, *Khasi*, *Tho*, *Nong*, *Cham*, *Shamray*, *Charay*].

Burmese [comprising *Burmese proper*, *Arakanese*, *Chin*, *Karen*, *Manipuri*, *Meithis*, *Singpho* including *Kuki*, *Naga*, *Lushai*, etc.; *Talaing*, *Kakhyen*, etc.].

Chinese [comprising *Chinese proper*, *Hoklo*, *Hakkel*, *Punti*].

American Indians.

Northern.

[Comprising—(1) *Eskimo* (Innuvit, Alut, Karalit), (2) *Athapascan*, *Dene*, *Navaho*, *Apache*, *Chippewayan*, *Tascully*, *Hupa*, *Umpqua*, etc.); (3) *Thlinkit*; (4) *Haida*; (5) *Timshian*; (6) *Kolushan*; (7) *Algonquin* (*Ojibway*; *Delaware*, *Blackfoot*, *Fox and Sauk*, *Mohican*, *Shawnee*, etc.); (8) *Iroquois* (*Huron*, *Mohawk*, *Onononga*, *Tuscaror*, *Cayuga*, *Seneca*); (9) *Natze*, (10) *Pawnee*; (11) *Muskogean* (*Choctaw*, *Creek*, *Seminole*, *Chickasaw*, *Apalachi*, etc.); (12) *Sioux* (*Dakota*, *Omaha*, *Crow*, *Osage*, *Assiniboin*, *Iowa*, etc.); (13) *Shoshonean* (*Moki*, *Comanche*, *Utah*); (14) *Salishan*; (15) *Pueblo* (*Zuni*, *Tao*, *Tusaya* etc.); (16) *Shahaptian*; (17) *Caddoan*; etc.].

Central.

[Comprising—(1) *Nahutlan* or *Mexican* (*Aztec*, *Pipil*, etc.); (2) *Huastecan* or *Maya*—*Quiche* (*Maya*, *Huastec*, *Toltec* (?), *Quiche*, *Chol*, *Mame*, etc.); (3) *Choco*; (4) *Totonac*; (5) *Mixtec*; (6) *Zapotec*; (7) *Chorotegan*; (8) *Talamanca*; (9) *Otomitlan*; (10) *Bribri*; (11) *Lencan* (*Chontal*, *Paya*, *Wulwa*; etc.)].

Southern.

[Comprising—(1) *Chibcha*; (2) *Quichua* (*Inca*, *Chanca*); (3) *Aymara* (*Colla*, *Calchaqui*); (4) *Cariban*; (5) *Arawak*; (6) *Fuegian*; (7) *Pona*; (8) *Patagonian*; (9) *Ticuna*; (10) *Bororo*; (11) *Chiquito*; (12) *Miku*; (13) *Botocudo*, etc., etc., etc.].

Note.—Such peoples as the *Mois*, *Mons*, *Nagas*, *Kuis*, *Karens*, *Ciampas* are by some authorities regarded as Palaeo-Mongols, whereas the *Anamese*, *Burmese*, *Khmers*, *Shans*, *Nicobarese*, *Igorrotes*, are reckoned as hybrids.

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